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Newspapers' Political Differentiation

A Multi-homing Approach

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Abstract

In this paper, we propose a theoretical model of a two-sided media market which examines the dynamic between newspapers, consumers and advertisers. We also review the existing literature on bias in media divided into sections on supply-driven media bias, demand-driven media bias, and empirical evidence of the existence of media bias. In our model, we relax the assumption that consumers buy only one out of multiple products, in line with recent contributions to the field. We also assume that consumers value both reading news closer aligned with their own political opinions, as well as reading news of high quality. They put relative weights on the two according to the verifiability of each piece of news. We find that allowing consumers to buy both newspapers drives the newspapers political differentiation to a minimum as they gather in the center of the political spectrum. The model is the first of its kind since it combines multi-homing, endogenous newspaper locations, the presence of advertisers, and a verifiability dimension. Thus, this paper covers a topic not yet examined in the literature on media bias, multi-homing, and two-sided markets.

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1 Introduction

In the aftermath of the 2016 United States presidential election, the topics of media bias, fake news, and the role of social media has been increasingly discussed.[1] The established mass media has been heavily criticized for leaning left by both prominent politicians and newsreaders with various political affiliations.[2] At the same time, conservative news outlets have been criticized for being overly biased towards the right. Alterman (2003) discusses the media bias of the conservative media outlets, and claims that media personalities on the right are far more one-sided, ideological, and agenda-driven in their reporting than what is the case in the liberal media. The demand for alternative news sources has led to a massive traffic-increase to sites such as Breitbart or The Daily Wire on the far-right side of the spectrum and Slate or the New Yorker on the left. Additionally, as social media's popularity has increased exponentially, the living conditions for fake news have improved vastly.

In simple terms, media bias manifests itself when different media outlets deviate from objective reporting. This bias can occur both intentionally and unintentionally, stemming from an agenda or sheer incompetence. Though, one can argue that objective reporting is impossible to obtain since editors, journalists, advertisers, and readers all have their political views which shape the media market.

The online dictionary *yourdictionary.com* defines media bias as "political bias in journalistic reporting, in programming selection, or otherwise in mass communications media". A term that is closely related to media bias and widely used in academic papers is slanting. This term was first used by Hayakawa (1947). He defines slanting as "the

[1] The discussion of these topics extends to academia. For example, see Allcott and Gentzkow (2017).

[2] This is the topics of the bestselling books by non-academics Bernard Goldberg (2001) and Al Franken (2003). Goldberg gives a *insiders* view of how CBS have slanted their news reporting in order to appeal to liberal voters, while Franken attacks the right side politicians and claims that the allegedly liberal bias is a hoax. Both books reached number 1 on The New York Times Best Seller list.

process of selecting details that are favorable or unfavorable to the subject being described" (Hayakawa, 1947, p. 48). This definition of slanting is widely used when analyzing media bias (e.g. Mullainathan and Shleifer, 2005 and Xiang and Sarvary, 2007) as it translates to the fact that editors and journalists can selectively choose which information to publish. By withholding information, editors and journalists can slant news reports favorably or unfavorably towards people or events.

The academic discussion of media bias can generally be seen to start among journalists. Such research can be traced back to the seventies, where Robinson (1972) examines media bias in the 1968 United States presidential election and Epstein (1977) discussed how media determines what should be classified as terrorism. However, the central economic research came later.

While the discussion of a biased media has persisted for long time in the United States, this issue is also relevant overseas. For instance, after the Norwegian parliamentary election of 2017 the previous prime minister for the Labour Party and current Secretary General of the Council of Europe, Thorbjørn Jagland, accused the Norwegian media of having a political agenda. The background was that a number of controversial news reports about the current candidate of the Labour Party was published shortly before the election. Jagland claims this would be a democratic problem. He wrote: "If it is such that the media houses knew about these issues long before the election, but waited to publish them until the election campaign, it becomes a direct intervention in the election and becomes a democratic problem. The media have a commitment to bring news immediately as it comes into their hands, and cannot wait until it fits best" (cited in Karlsen, 2017).[3] In an editorial, the chief editor of Nettavisen.no, Gunnar Stavrum (2017), criticized Jagland for blaming their poor result on the media. He asks Jagland to apologize for his accusations or to document what he claims.

[3] Our translation.

Just like in the United States, it is also a widespread perception in the Norwegian news market that different newspapers hold different political views which influence their content (see e.g. Jamtøy, 2011). Anecdotal evidence is consistent with this view. Figure 1 is adopted from a survey conducted by Kantar Media, using telephone interviews with a sample of 13,970 Norwegian adults aged 18 or older.[4] This survey suggests that left leaning consumers prefer reading Dagbladet, while right leaning consumers prefer reading Nettavisen.no, implying that the different newspapers has a political angle in their presentation of the news.

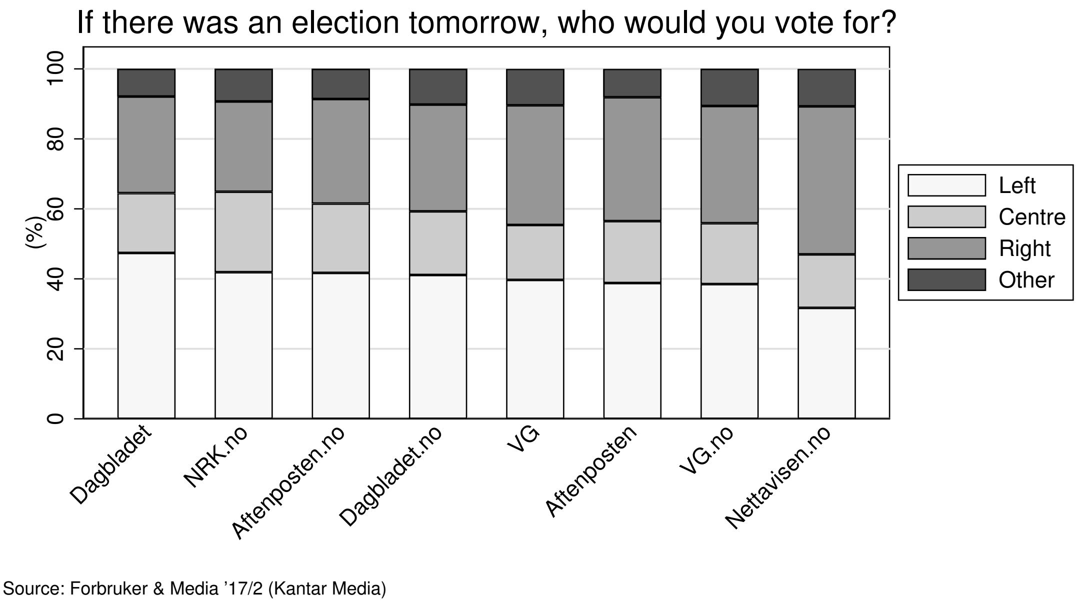

Figure 1: Political preferences of Norwegian newspaper readers

Even though most Norwegian newspapers no longer hold official political positions, we

[4]In the figure, the political parties categorized as left are the Red Party (*"Rødt"*), the Socialist Left Party (*"Sosialistisk Venstreparti"*) and the Labour Party (*"Arbeiderpartiet"*). Those categorized in the center are the Green Party (*"Miljøpartiet De Grønne"*), the Center Party (*"Senterpartiet"*) the Christian Democratic Party (*"Kristelig Folkeparti"*) and the Liberal Party (*"Venstre"*). Finally, those categorized as right are the Conservative Party (*"Høyre"*) and the Progress Party (*"Fremskrittspartiet"*). The remaining sample categorized as others include those who do not vote, vote for minor parties or for other reasons have not answered.

can see some clear patterns from the former Norwegian "party press" that is consistent with Figure 1.[5] Dagbladet and Aftenposten, for example, has historically been loyal to the Liberals and the Conservatives, respectfully. VG, on the other hand, was party-independent, but has been known to be politically located within the "non-socialist" bloc (Allern, 2010; Dahl, 2014). In two interesting papers, Allern (2007, 2010) studies these patterns in more detail by making use of content analysis. He tracks the coverage of national elections from the 1960s to 2009 in several local and nationwide newspapers. His results indicate that the modern coverage of elections in some newspapers is affected by the newspapers' political background.

An interesting feature of the press industry is that its profitability is highly dependent on advertisers. In fact, the press industry gets a significant share of its financing by selling advertisement to advertisers. Especially in a time where consumers often read news on the Internet for free, the importance of advertisers is evident. Accordingly, most newspapers are sold twice: First to the readers who buy the content of the newspapers, and then, second to firms and advertisers who buy advertisement spots in order to promote products to the readers of the newspapers. This feature of the press industry is by economists referred to as two-sidedness, meaning that newspapers sells their product to two distinct sides of the market. We provide a general discussion of two-sided markets in section 2.2.

The fraction of newspapers' financing that stems from advertisers vary across countries. According to Gabszewicz, Laussel, and Sonnac (2001, 2002), Albarran and Chan-Olmsted (1998) and Picard et al. (1989) reports that the fraction of newspapers revenues accruing from advertisers was 40% in France, 45% in Spain and over 50% in the "Nordic" region, while it could even reach 80% in the United States. Figure 2 shows

[5]The "party press" refers to the time when Norwegian newspapers were owned by political parties or through other mechanisms had a clear political affiliation. By the 1990s, the "party press" was almost entirely abolished as most newspapers no longer had economic gains from upholding a strong political affiliation (Allern, 2007).

updated data for the Norwegian market for printed newspapers (panel a), and digital newspapers (panel b). As one might imagine, revenue for printed newspapers has a downward sloping trend while the opposite is the case for digital ones. In the case of printed newspapers, it seems that the share of advertising revenues remains constant. As for the digital newspapers, the advertising share seems to lower as circulation revenues increase.

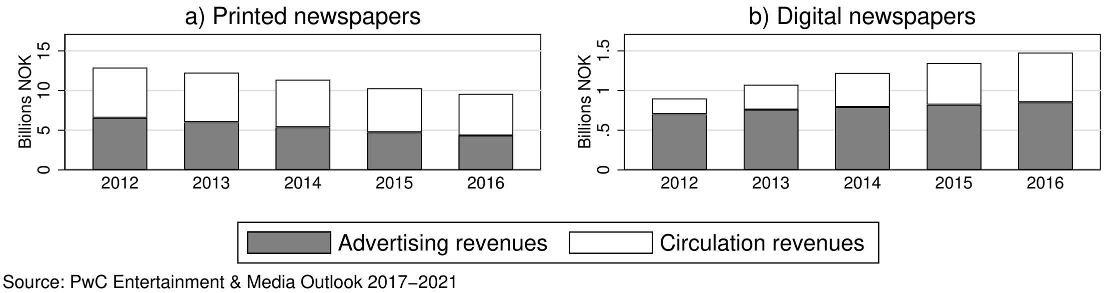

Figure 2: Advertisement and circulation revenues for Norwegian newspapers

There is an ongoing discussion on how the competition for consumers and advertisers affects the diversity of the media. According to Garcia Pires (2014), Herman and Chomsky (1988) argue that fiercer competition for advertisement will lead to less diverse media, given that news outlets needs to appeal to more mainstream consumers in order to attract advertisers. A possible result of a less diverse media is that news outlets will gather at the center of the political spectrum, instead of publishing news reports with varying political slanting. The idea that the media holds a single view in their reporting is synonym to the french term “Pensée Unique”, which translates into “single thought”.[6] Gabszewicz et al. (2001, 2002) formalizes Herman and Chomsky’s argument as they show that the presence of advertisers may lead to the ascent of the “Pensée Unique”.

Steiner (1952), Beebe (1977) and Spence and Owen (1977) represent some of the first

[6] As far as we know, the term “Pensée Unique” was coined by the French newspaper editor Jean-François Kahn in an editorial in 1992.

articles written on the economics of the media-market. The early literature on media economics analyzed the matching of types of broadcasting programming produced and the benefit it generates to consumers in the market (Anderson and Coate, 2005). Steiner (1952) conclude that the most popular types would be duplicated excessively, while Spence and Owen (1977) find that special types of programs would tend not to be provided. Downs (1957) is one of the first economic analysis of information's role in a political competition. His argument was that the rational political voter should delegate the gathering of information to an agent (i.e. a newspaper) whose opinion is close to her own.

Among Industrial Organization scholars it has traditionally been assumed that consumers buy one and only one product, in a multi-product world. This is a strong and perhaps even unrealistic assumption of consumer behavior. We can imagine several markets and situations where this assumption does not hold. The market for news is certainly one of them. Even though a consumer reads a financial newspaper at breakfast, he would still be interested in reading a tabloid at lunch. Gentzkow (2007) studied the market for newspapers in Washington D.C. He found that one third of his sample reads more than one newspaper daily. A survey by TNS Gallup showed that Norwegian consumers on average reads 1.9 newspapers daily (Svendsen, 2008). Therefore, it is imperative that economic theory implements the possibility of multiple purchases when analyzing the newspaper market. Relaxing the assumption of one and only one purchase is often referred to as multi-homing.[7] We provide a review of the relevant literature in relation to multi-homing in section 2.3.

We make use of Hotelling's (1929) simple model for horizontal differentiation in a two-sided market where we allow for multi-homing. The model consists of readers,

[7] Different authors use different names for allowing consumers to buy several products. Kim and Serfes (2006) use "multiple purchases" and Anderson, Foros, and Kind (2017) use "multipurchasing". Anderson, Foros, and Kind (2016) and Choi (2010), on the other hand, uses multi-homing. We regard the names as synonyms, and choose to consistently use multi-homing.

advertisers, and newspapers, which through a sequential game reach an equilibrium. We analyze two iterations of our model. In the first, readers do not care about quality in news reporting. In the second, they put relative weights on quality and reading news closer aligned with their own political preference according to the verifiability of a news report. In the case where readers do not care about quality our main result is that newspapers will congregate in the center of the political opinion continuum given a sufficiently low transportation cost. The result is the same for when readers care about quality. However, the result in this case depends on sufficiently high investments costs and that the parameter for news verifiability is interior.

A glaring question arises when examining the methodology of our model specification. Is the equilibrium solution we reach a stable one? Or does it break down in the same way Hotelling's principle of minimal differentiation did? We find that as long as some, but not all, consumers engage in multi-homing, the model ensures a stable equilibrium.

The rest of this paper is structured as follows. In section 2, we offer an overview of the existing economic literature on product differentiation, two-sided markets, multi-homing and media bias. In section 3 we present a locational media market model with multi-homing consumers. In section 4, the equilibria are derived and analyzed. Section 5 concludes.

2 Literature review

Even though economists only recently started analyzing the possible bias in the market for news, there is already a large number of academic papers addressing different aspects and research questions in the field of media bias. Because of this, there has already been written several surveys of the economic literature on media bias. Gentzkow and Shapiro (2008) review the contributions regarding the effects of competition in news markets on the accuracy of news. DellaVigna and Gentzkow (2010) reviews the empirical literature on the effects and drivers of persuasion of consumers, voters, donors and investors. Blasco and Sobbrio (2012) reviews the literature addressing the influence of advertisers on the accuracy of the news media. Prat and Strömberg (2013) reviews the political economy literature on the influence of mass media on politics and policy. Groeling (2013) offers a review of the empirical literature on media bias. He discusses different approaches and explores strategies and tools used to study media bias. Sobbrio (2014) briefly reviews both the empirical and theoretical literature analyzing the distortions present in the media-market.

Following the style of existing reviews, we categorize the literature on media bias into two categories based on what research question that is being addressed. One part of the literature investigates a supply-side explanation to media bias: that the bias in a given media's report of the news is due to the preferences, opinions or motives of the agents working in a given medium. Alternatively, the bias present in media-market can be explained by the demand-side: that consumers' demand cause profit maximizing media outlets to report biased news. In addition to this, we summarize some of the empirical work done on the topic.

The rest of this section is organized in the following order: First, we provide a brief introduction to the theories concerning product differentiation as this will play an important role when we later turn our attention to models analyzing the media-market and possible bias therein. Second, we give a short review of the literature on two-sided markets. Third, we introduce multi-homing and review relevant and recent contributions. Fourth, we review some of the most influential articles analyzing media bias empirically. Fifth, we give an in-depth review of the theoretical literature on media bias, where we split the review between articles concerning supply-side and demand-side. Lastly, we give some remarks on the literature and identify some paths for future research.

2.1 Product differentiation

Analyses of markets with price competition often start out with a standard Bertrand approach. In such an approach, one often assumes that the goods traded are perfect substitutes. This assumption implies that all customers at any time will buy the cheapest good available, and that every producer hence can capture the entire market by undercutting the price set by its rivals. The Bertrand paradox, named after its creator Joseph Bertrand, describes the situation where this behavior lasts until price is equal to marginal cost and no producer will have any incentive to further lower its price.[8] Hence, producers try to avoid ending up in this situation in order to make a profit. Product differentiation is a possible way out of the Bertrand paradox.

When seeking a strategy of product differentiation producers have two options, namely horizontal and vertical differentiation.[9] Vertical differentiation refers to the strategy of diversification along a continuous or discrete scale where some aspect of the product, for example quality, can be objectively graded from worst to best. In the media-market this may manifest itself if newspapers compete about offering the best journalism, if such an objective measure exists, and therefore compete for the best journalists.

[8]When all producers are charging marginal cost, it means that also all profit, producer surplus, is lost. This also implies that the consumer surplus is at its maximum.

[9]The distinction is made clear by Lancaster (1979).

In this paper, however, we are mainly concerning ourselves with horizontal differentiation. Horizontal differentiation refers to the idea that consumers have heterogeneous preferences, and hence disagree about what is better. For example, two consumers might disagree about what car is the best and will therefore make different purchases even though the two cars share many features and is objectively seen to be of the same quality. In differentiation analyses, one may make use of a monopolistic competition framework or one of spatial analysis.

Product differentiation in monopolistic competition was proposed by Chamberlin (1933) who argued that each seller will have some degree of market power as long as his product is not exactly similar to the competitor's. While each seller competes against "the market" in Chamberlin's monopolistic competition, the opposite is true for spatial analysis.[10] In spatial analyses each seller competes against other firms in duopolies or oligopolies.

An important tool in the spatial analysis of horizontal differentiation was presented by Harold Hotelling in his seminal paper from 1929. Later, it has been named after its original creator and is commonly referred to as *Hotelling's Linear City*. In this simple "city" there are two firms competing for customers uniformly distributed along a line with a normalized length of 1.[11]

Figure 3 is a graphical illustration of the linear city. The two firms, A and B, compete over consumers that reside along the line, which incur a transportation cost of traveling to one of the firms. The transportation cost is increasing in the distance the consumer will have to travel, and hence, the longer the consumer must travel, the lower is the achieved utility from buying a product. If the firms charge the same price, then all customers will simply buy from the firm located closest to themselves. The transportation

[10] As a distinction between monopolistic competition and spatial analysis, it is assumed in former that a change in price by a firm does not affect the demand faced by other firms (Tirole, 1988).

[11] In Hotelling's original formulation, the linear city is actually of length l. It has later been the custom to simply use length 1, as this does not change any of the original results.

cost can be thought of as the additional time it takes to travel to a store, or simply the disutility of consuming something that does not match one's exact preferences. One important assumption commonly used when applying the model is market coverage: all consumers will buy from either firm A or firm B.

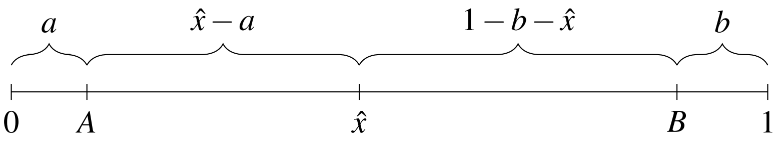

Figure 3: Hotelling's Linear City

In Figure 3, the indifferent consumer, who is indifferent between buying from firm A and firm B, is located at point $\hat{x}$. If he choose to purchase from A, he will incur a transportation cost $t(\hat{x}-a)$, while he will incur a transportation cost $t(1-b-\hat{x})$ by purchasing from firm B, where t is the intensity of preference for consuming products closer aligned with his location. In this stylized model, because the prices are equal, the indifferent consumer is located in the middle between the two firms. If, for example, firm A lowers its price for the product, the indifferent consumer would move slightly towards firm B because the sum of both the price and the transportation cost of buying from firm A is now slightly lower.

In his original formulation of the model, Harold Hotelling specified consumers' utility functions with linear transportation costs (i.e. $f(d) = d$ where d is the distance from a consumer to a given producer. This implies distances $d_A = (\hat{x}-a)$ and $d_B = (1-b-\hat{x})$ in Figure 3). Hotelling found that it was rational for producers to make their products as similar as possible. This is called *The Principle of Minimum Differentiation*.[12] The observation is based on the fact that a producer can earn a marginally larger market share by moving marginally towards the center of the Linear City. This behavior will continue until the producers are located on the same place, and because location is a

[12] Also referred to as *Hotelling's Law*.

parameter for horizontal differentiation, this implies minimum differentiation.

The Principle of Minimum Differentiation was re-examined by d'Aspremont, Gabszewicz, and Thisse (1979). First, they pointed out that because a key calculation in Hotelling's paper was incorrect, the result of producers imitating each other is actually that it eventually leads to the Bertrand paradox. Hence, they argue that there is no equilibrium with minimum differentiation. Second, d'Aspremont et al. showed that by substituting linear transportation costs in consumers utility functions with quadratic transportation costs (i.e. $f(d) = d^2$) there exists a maximal differentiation equilibrium, in which producers locate at the extremes of the Hotelling line.

Economides (1986) confirmed the findings of d'Aspremont et al. He also showed that the maximal differentiation equilibrium only holds for utility functions with quadratic transportation costs and is hence false in general. Additionally, he considered less a convex transportation function (i.e. $f(d) = d^\alpha$ where $1 < \alpha < 2$) and found that that there exist utility functions with "intermediate" α's such that the equilibrium have interior positions on the Hotelling line. Böckem (1994) also offer an alternative explanation that falsifies maximal differentiation as a general result. Böckem extended the consumers' decision set by assuming that consumers not only differ about their preference for the good, but also in their willingness to pay. This implies that consumers differ in their valuation of the outside options. She found that this changes the location decision by the platforms as it shifts the trade-off between relaxed price competition and increased demand effect. This leads to interior equilibrium locations.

Another tool commonly applied for spatial analyses of markets with horizontal differentiation is *Salop's Circular City* derived by Steven Salop and presented in his 1979 article. In the circular city, firms are located along a circle which represents the differentiation. Unlike the Linear City, in Salop's model the number of firms is not exogenously determined and is therefore a useful tool for analyzing the entry decisions of firms as well as the optimal number of firms to compete in a given market.[13] For the rest of this paper we will for the most part concern ourselves with the duopoly setting presented by Hotelling.

When analyzing the media-market, Hotelling's model is commonly applied. Instead of thinking of the length of the city as a physical distance, it is instead thought of as the political spectrum ranging from the far left (0) to the far-right (1) as the most extreme positions. Media outlets hold a political position somewhere on the line, and the consumers' political opinions is distributed along the line. When using this framework to analyze media bias, it is assumed that consumers to some degree value reading news that are aligned with their own political opinions. The transportation cost is then the disutility a reader with a given political position incurs by reading news from an outlet that hold a political position different from his or her own. A possible explanation of media diversity is therefore that because consumers hold different political views, newspapers adjust their political positions to cater to these preferences and maximize profits. This is hence labeled the demand-driven media bias, because media is biased due to a demand for different presentation of news among consumers. However, as we will see, this assumption is not used by all scholars as some assume consumers to be fully rational and only value learning the truth. These authors explain the presence of media bias by other mechanisms.

2.2 Two-sided markets

The field of two-sided markets emerged at the start of the new millennium, and the progress was summarized by Rochet and Tirole in their review article from 2006. Most markets can be said to exhibit two-sidedness because they serve two sides, namely buy-

[13] A third, and recent contribution is the *Spokes model* derived by Chen and Riordan (2007). The Spokes model is a hybrid of both Hotelling's Linear City and Salop's Circular City as the number of firms is endogenous and it also opens for multi-product firms.

ers and sellers. However, when referring to two-sided markets we are speaking about specific types of markets. Following the definition provided by Evans (2003), a market needs to fulfill several criteria to be classified as two-sided. First, there has to be (at least) two distinct user groups.[14] Second, the user groups needs to provide each other with network benefits. Finally, the market needs to have an incumbent platform or organization that can internalize externalities between the different user groups.

While the seminal work of Rochet and Tirole (2002) focused on the economics of payment card associations in order to conceptualize the idea of two-sided markets, the theory has been applied to a wide range of platforms and organizations that fulfill the criteria for a two-sided market, such as dating sites, game consoles and marketplaces.[15] Evans and Schmalensee (2008) suggested to classify the types of platforms into four broad categories: exchanges (e.g. eBay and Amazon), advertiser-supported media, transaction systems (e.g. credit cards) and hardware/software platforms (e.g. video games and consoles).

Interestingly, much of the literature on two-sided markets subsequent to Rochet and Tirole (2002) has concerned itself with the media-market. The media-market is a two-sided market because media platforms (e.g. television, newspapers and radio) internalize the externalities between two user groups, namely consumers and advertisers. What makes the media-market special is how the two user group interact. In most two-sided markets, there are positive externalities between the two groups. For example; both (heterosexual) men and women prefer dating sites with more users of the other group. However, this externality is not necessarily positive in the media-market.

[14] In theory, there can be a large number of user groups in the market, such a market would instead be referred to as a multi-sided platform. For simplicity, we are only taking two user groups into account.

[15] Payment card associations are two-sided because they serve two distinct user groups (consumers and merchants) and they have positive externalities: consumers prefer payment cards that are accepted by more merchants, and merchants prefer cards that are carried by more consumers. Payment card associations, such as Visa and MasterCard, internalize this.

While it seems obvious that advertisers want to reach as many potential customers as possible, and hence prefer media platforms with more consumers, it is not evident that consumers feel the same way about advertising. The sign of this externality is an empirical question that has been discussed for a long time without any clear answer. Kaiser and Song (2009) investigate whether consumers dislike advertisement in the German market for magazines using logit demand models. They find no evidence of readers disliking advertisement. Interestingly, they find that magazine readers might actually appreciate advertisement. A similar analysis is conducted by Depken and Wilson (2004), who examines 95 U.S. magazines and concludes that there is substantial heterogeneity. They find that advertisement is positive in some categories, and negative in others. On the other hand, Moriarty and Everett (1994) and Wilbur (2008) provide evidence of a negative effects in the TV market. Moriarty and Everett conducted an experimental study, and found that 90% of channel changes is done during commercial breaks. Wilbur used data on the 50 largest U.S. TV markets, and found viewers' dislike of advertisement to be positive and significant. Several theoretical studies of two-sided media markets include advertisement as a negative nuisance cost (e.g. Kind, Nilssen, and Sørgard, 2007, 2009). However, in our model, we do not.

Empirical evidence confirms that media markets share the properties of two-sided markets. For example, using German data on the market for magazines, Kaiser and Wright (2006) found evidence that implied that consumer prices are subsidized and that magazines make all their profits from the advertiser side of the market (Sriram et al., 2015).

Externalities between agents is not a new feature of economic models. However, the early literature on externalities ignored the questions of the pricing structure and the possible negative externality that exists if consumers dislikes advertisement (see e.g. Katz and Shapiro, 1985, 1986). Figure 4 illustrates a two-sided media-market on the Hotelling line where p_A and p_B are the consumer prices charged by the platforms while

s_A and s_B represents the tariffs paid by advertisers.

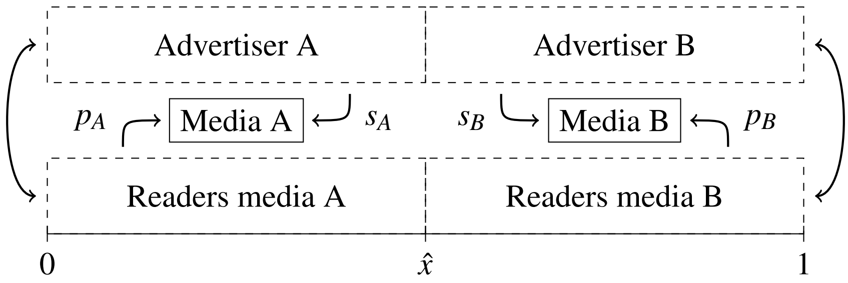

Figure 4: Map of a two-sided market under single-homing

Other pioneering research within the field of two-sided markets is found in Caillaud and Jullien (2001, 2003) who pointed out that for a platform to attract either consumer group it needs the other group to be on board in using the platform. Clearly, a newspaper without readers is of no value for an advertiser. This so-called chicken-and-egg problem is solved by using the right pricing strategy.[16]

The pricing structure in two-sided markets will depend on three factors, according to Armstrong (2006). First, how the externalities affect the other user groups, in addition to the relative size of the cross-group externalities. Armstrong illustrates the pricing mechanism of two-sided markets with the example of a nightclub: if men gain more from interacting with women than vice versa, we would expect there to be a tendency for nightclubs to offer lower entry fees to women than to men (Armstrong, 2006, p. 669). Second, it depends on whether the platform is charging per-transaction or lump-sum. Cross group externalities will be weaker in a platform charging per-transaction because a part of the marginal benefit of an additional user on the other side is eroded by the increased payment incurred. Armstrong shows that the platform profits might be higher when charging per-transaction due to the weaker externalities. Third, whether any of the groups are single-homing or multi-homing will have a significant impact on the prices

[16]As far as we know, Caillaud and Jullien were the first to use the chicken-and-egg analogy to address the problem faced by platforms operating in two-sided markets in their 2003 article.

charged to each side.[17] For example, imagine a platform where group 1 is multi-homing and group 2 is single-homing. This gives the platform monopoly access to the single-homing customers, and group 2 has no other choice but to deal with the platform in order to access group 1. The monopoly power naturally leads to higher prices being charged to the multi-homing side.

2.3 Multi-homing

Although multi-homing originally was an Internet term referring to when a host has more than one connection to the Internet, Caillaud and Jullien (2003) applied the term for use in an Industrial Organization setting (Doganoglu and Wright, 2006).[18] Multi-homing is defined as a characteristic of some markets where the customers use two or more of the platforms which exist in the particular market. Consumers using several credit cards, newspaper consumers reading more than one newspaper, or video game players using both *Steam* and *Good Old Games* as a game purchasing platform are all examples of this market characteristic. In the introduction, we pointed out the need for economic models to allow consumers to buy several newspapers as this is an imitation of reality. Alternatively, Peitz and Reisinger (2015) argues that single-homing might be a reasonable assumption for the TV market. Their argument is based on the fact that each viewer only can watch one channel at a time. They write that if advertisers can choose the time their ads will be broadcast, they will choose the same time for all channels. This way the advertisers avoids paying for the same viewers several times. In this case, from the advertisers' point of view, consumers single-home (Anderson et al., 2016).

[17]Single-homing refers to when a agent chooses one and only one platform, in contrast, multi-homing refers to when a agent uses several platforms. This is discussed in more detail in section 2.3.

[18]Cremér, Rey, and Tirole (2000) analyzes multi-homing in the Internet setting. For example, multi-homing covers the practice of connecting to an Internet host with several Internet Service Providers in order to stay connected even if one should fail.

A major weakness of Hotelling's original formulation of the Linear City is that the model does not allow consumers to purchase more than one of the products, and the model is therefore inadequate to analyze markets where this is common consumer behavior. This weakness of the Hotelling model has, however, been addressed recently. Kim and Serfes (2006) were among the very first scholars to analyze market outcomes when adding the possibility of buying both horizontally differentiated products. Kim and Serfes applied multi-homing to the Hotelling framework and showed that under certain conditions Hotelling's Principle of Minimal Differentiation is restored. The background for their result is that the firms want to increase the amount of consumers who buys both products. Kim and Serfes calls this effect the *aggregate demand creation effect*. Ambrus and Reisinger (2006) were the first to show that the predictions of a single-homing model would change considerably by adding multi-homers, while the presence of multi-homers could lead to instability issues in the Hotelling model.

Figure 5 illustrates multi-homing among consumers in the Hotelling model where each firm is located at the extreme locations, i.e. $(a,b) = (0,0)$. In the figure, u_A^R is the utility of consumers purchasing from firm A, and u_B^R is the utility of consumers purchasing from firm B. Further, u_{AB}^R is the utility of consumers who engage in multi-homing, and purchases from both firm A and B. Note that the utility derived from buying both goods in the end of line situation is constant and independent of the location of the consumers. This is because the consumers will have to travel the full distance to buy both goods. The indifferent consumers x_{AB} and x_{BA} are the consumers who are indifferent between buying from only firm A or both and only firm B or both, respectively. This implies that consumers located between the two indifferent consumers will buy both, while the ones on the left of x_{AB} will only buy from firm A and the ones on the right of x_{BA} will only buy from firm AB.

The demand faced by the two firms is therefore made up of both the single-homers and

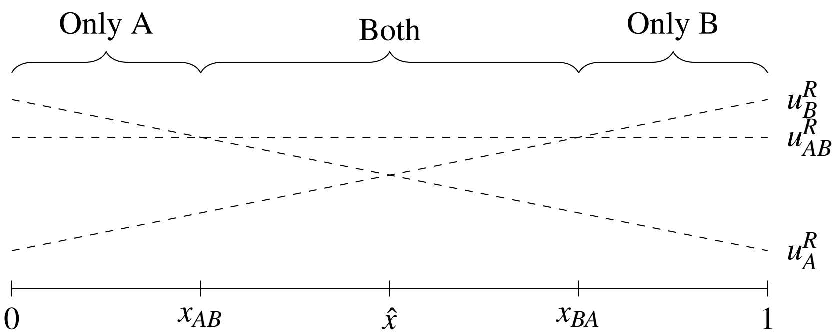

Figure 5: Indirect utility of multi-homing with maximal differentiation

the multi-homers. The total demand for firm A is all consumers located left of x_{BA}, while the demand for firm B is all consumers located right of x_{AB}.[19] Similarly, this can be expressed as $D_A = x_{BA}$ and $D_B = 1 - x_{AB}$, respectively.

In single-homing models we know that the prices charged by the firms will be strategically dependent on each other, because a change in price will impact the demand faced by the competing firms. However, this insight is no longer valid when we introduce multi-homing into oligopolistic models, as prices in such a setting are independent of each other (Anderson et al., 2017; Kim and Serfes, 2006). To explain this seemingly counter intuitive result of price independence, assume an incremental decrease in the price of a good sold by firm i in a duopoly consisting of firm i and j where consumers multi-home. A decrease in the price of firm i's product certainly increases demand faced by firm i, but it does not affect the demand faced by firm j.

The reasoning behind this property is that instead of substituting firm j's product with firm i's product because of the price decrease, some of the consumers who originally only consumed firm j's product supplement their consumption with a product from firm i. The consumers who preferred firm j's product before the price change will still prefer it after the price change, but some of them will now choose to buy from firm i

[19] The demand for firm A is the consumers with $x \in [0, x_{BA}]$ and the demand for firm B is the consumers with $x \in [x_{AB}, 1]$.

in addition. Thus, the demand faced by firm j is unaffected by the price change of firm i, and there is no incentive for firm j to change its price. Consequently, multi-homing cancels the business stealing effect that is present in single-homing models and soften price competition.

Softer competition in price is the driving force that restores Hotelling's Principle of Minimal Differentiation, as noted by Kim and Serfes (2006). While d'Aspremont et al. (1979) showed that minimal differentiation would lead to the Bertrand paradox in models of single-homing, this is not the case when we allow consumers to buy both goods. Because prices are now independent on the competing firms, each firm will have an incentive to locate closer to the middle in order to minimize the distance to as many customers as possible. In multi-homing models, the fact that a consumer purchases from one firm, does not prevent her from buying from the other. Therefore, the fact that both firms move closer to the middle does not intensify price competition.

Armstrong (2002, 2006) showed that single-homing consumers in two-sided markets leads to *competitive bottlenecks.* That is, when all consumers only buy a single newspaper there is no effective competition for advertisers, as platforms instead focus on subsidizing consumers to join.[20] Anderson et al. (2016) show that direct competition for advertisers ensues if consumers multi-home. They identify *the principle of incremental pricing*, which implies that platforms price advertisement according to the incremental revenue an advertiser achieves from an additional advertisement. A central feature of their model is that consumers who buy both goods are less valuable to platforms because advertisers achieves a lower utility by reaching a consumer a second time. Because of this, platforms may want to differentiate from rivals in order to deliver exclusive consumers to advertisers.

[20] Armstrong and Wright (2007) explores the possibilities of avoiding competitive bottlenecks by offering one side of the market (e.g. advertisers) to sign exclusive contracts. They find that exclusive contracts provide an easy way to persuade multi-homing sellers to abandon the rival platform.

Further, Anderson et al. (2016) also analyze how the principle of incremental pricing and multi-homing affects the firms' choice of location in the Hotelling model. First, they find that the location choice is the same in a two-platform monopoly and as it is under competition. This feature is due to the fact that each platform makes their location choice independent of the competitors' choice. Second, they find that the location choice is contingent on the value the platforms puts on reaching a consumer who buys multiple goods. Specifically, if platforms only value exclusive consumers, the platforms will locate far from the middle. Alternatively, if platforms also value consumers who multi-home, they will move closer to the middle of the model in order to attract valuable multi-homers. They show that in the special case where platforms value exclusive consumers and multi-homers equally, that is, they only care about maximizing total demand, the location choice of the platforms will be in the middle. The latter result is hence a duplication of Kim and Serfes' aggregate demand creation effect that restored the principle of minimal differentiation.

Athey, Calvano, and Gans (2016) is an interesting contribution to the media economics literature. They inquire into the implications of multi-homing on advertisers and publishers. Athey et al. argue that consumers multi-home at an increasing rate because of the Internet and social media. The authors assume heterogeneous advertisers. Specifically, that means advertisers place value v on reaching each consumer, where preference v is uniformly distributed between 0 and 1. The advertisers are then categorized into moderate- or high-value based on this distribution. From the model results, Athey et al. infer that multi-homing induces advertisers to act selectively. That is, high-value advertisers tend to target multiple publishers since they place a higher value on advertising on multiple publishers compared to the market price of advertisements. Meanwhile, Athey et al. find that some moderate- and lower-value advertisers target a single publisher in order to make sure every ad they buy make it to a fresh customer. For these advertisers, targeting more publishers would not be profitable, as the loss from duplication would be so large that the value of advertising is lower than the market price. Furthermore, the reaction of many advertisers to target one single publisher because of multi-homing consumers leads to a reduced demand for advertisements, which causes ad prices to drop. Consequently, publisher profits fall. Athey et al. propose mergers as a possibility to counteract the negative ramifications of increased multi-homing. By merging, the publishers can pool user information and become more attractive to advertisers. In addition, the authors find that in the struggle to attract and hold on to the largest possible number of unique users, platforms are incentivized to increase investments in quality.

Ambrus, Calvano, and Reisinger (2016) as well as Anderson et al. (2016) explain lower advertisement prices with different mechanisms. Ambrus et al. identifies the *business-sharing effect*, which explains lower ad prices due to opposing consumer preferences.[21] That is, when there are big differences among consumers in terms of their preferences, the share of exclusive consumers is likely to be high. The intuition is that different newspapers will try to accommodate different preferences. When this is the case, a marginal increase in advertisement by a newspaper is unlikely to make exclusive consumers switch platform. Therefore, platforms are incentivized to have high levels of advertisement which drives down prices. The principle of incremental pricing from Anderson et al. (2016) tells us that platforms compete down the prices of advertisement in order to reach more multi-homing consumers.[22]

Multi-homing has also received attention in models of vertical differentiation. Gabszewicz and Wauthy (2003) extended the model of Mussa and Rosen (1978) for vertical differentiation by adding the possibility of multi-homing.[23] Gabszewicz and Wauthy

[21] It is worth noting that Ambrus et al. (2016) is a later, published, version of the previous working paper Ambrus and Reisinger (2006).

[22] Anderson and Jullien (2015) provide a survey of the economic mechanisms at work in recent models of advertising finance in media markets developed around the concept of two-sided markets. For an overview of the effects of viewer multi-homing in media markets, see Peitz and Reisinger (2015).

[23] In an interesting follow-up paper, Gabszewicz and Wauthy (2004) extends the model by acknowledging that media firms operate in two-sided markets and are therefore prone to network effects.

showed that adding multi-homing to the model affects the competition between a high quality and low quality firm.[24] One effect is that multi-homing leads to the low quality firm to sell one unit to the consumers characterized as "poor" and one unit to those characterized as "rich". This leads to fiercer price competition and could result in multiple equilibria. Another effect is that multi-homing could lead both firms to target the "rich" consumers, who are likely to buy both products. This would lead to softer competition.

Taking the theory a step further, Anderson et al. (2017) introduced the possibility of horizontal differentiation, and applied the Hotelling model. They assume that investments in quality are more appreciated by the consumers if the product is closer aligned with their preferences. Anderson et al. also introduced a notion of overlapping product functionality.[25] They assume that consumers valuation of buying both products is falling in the overlapping functionality. More specifically, the incremental utility of buying a second product is given $V_i = q_i - \beta q_0 q_1$, where q_i is the quality offered by firm i and β is a parameter that measures consumers preference for the same functionality in both products.[26] Anderson et al. find that if the measure for functionality β of both products lies above a certain threshold, the added consumer utility of buying a second product may disappear. Subsequently, fiercer competition will reduce prices so that they approach marginal costs. They further find that prices might have a hump-shaped relationship with functionality. Therefore, the firms could be incentivized to offer quality levels and prices so high that no consumer will buy both products.

The empirical literature on multi-homing is still relatively scarce. In a recent paper, Kim, Lee, and Park (2017) studies the effects of multi-homing agents in the market for

[24]As in the original formulation of the model by Mussa and Rosen (1978), offering high quality induces the firm to incur high cost. Alternatively, low quality imposes low cost.

[25]Related studies of multi-homing assumes that consumers are indifferent as to whether firms develop the same or different functionality (i.e. Guo, 2006; Kim and Serfes, 2006).

[26]If $\beta < 0$, consumers benefit from having the same functionality in both goods. Anderson et al. restrict their analysis to the case where $\beta \in [0,1]$.

daily deals.[27] The daily deals market is a standard two-sided market as the platforms needs to get both sides of the market on board, namely the consumers and the merchants. Kim et al. found that there are small or no differences in deal terms for comparable deals. They suggest that this result is due to the fact that consumers are multi-homing and that this leads to intense competition for consumers. Their results are also consistent with theoretical wisdom from two-sided markets, suggesting that platforms find it hard to create competitive bottlenecks when the agents are multi-homing.

2.4 Empirical evidence of media bias

In the process of analyzing media bias, two essential questions arise: Can media bias be measured, and if so, how widespread is it? In this section of the literature review, we review some of the most prominent papers which tries to answer these questions, however, many others have tried to find a way to quantify media bias.

Groseclose and Milyo (2005) were some of the first to empirically analyze the presence of media bias. Groseclose and Milyo create a measure of media bias for different prominent news sources in the United States market. In order to compute this, they use the number of times a news medium quote different think tanks and policy groups, and look at this in comparison with how often these organizations are cited in Congress speeches. They are then able to compute a score of *how liberal* each media outlet is.[28] Their results offer support to the sentiment that there exists some form of bias towards the left in the major newspapers in the U.S. market.

DellaVigna and Kaplan (2007) aim to study if media bias affected the 2000 United

[27] The daily deals market is consisting of firms that offer deals directly to the consumers for limited time period. Groupon dominates the European market with an market share over 80% in several European countries, while the U.S. market is more segmented with Groupon and LivingSocial being the market leaders (Kim et al., 2017).

[28] While the term liberal remain relatively close to its enlightenment era roots in Europe, it has become somewhat of a synonym for left-wing in the United States political discourse.

States presidental election where George W. Bush beat Al Gore. They study the entrance of right-leaning news outlet Fox News into the local cable television markets and consider whether exposure to Fox News have a significant effect towards voting republican. The method they applied to answer this question was to collect election- and cable programming-data from almost ten thousand U.S. towns and to compare the towns with newly received access to Fox News with the towns which does not have access. Then, they investigate the change in Republican voting share from 1996 to 2000. The main result of this empirical study is that they find significant evidence that supports the hypothesis of Fox News TV programming affecting voter behavior.[29] The towns where Fox news were introduced have a 0.4-0.7 percentage point higher chance of voting republican. Additionally, previously non-Republican voters were heavily impacted by the introduction of Fox News. Between 3 and 8 per cent of previously non-Republican voters were convinced to vote Republican.

An experimental study by Gerber, Karlan, and Bergan (2009) relates to the work done by DellaVigna and Kaplan (2007). Here, instead of people being introduced to Fox News, they conduct an experiment where three groups are given different news subscriptions. One group gets access to a left-leaning news source, another gets access to a right-leaning source, and the last is a control group.[30] This experiment has a surprising result; both groups given free news access significantly changed their political affiliation to the left of the spectrum (i.e. media access trumped media bias). The authors present possible explanations for this surprising result. One possible explanation considers the timing of the experiment. The experiment is conducted in a period when the republican party struggled nationwide and Bush's approval ratings were reduced from 40 to 37 per cent. Another possible reason is that the democratic candidate in the area of the

[29] The somewhat controversial estimates of DellaVigna and Kaplan suggested that the introduction of Fox News shifted 10,757 votes for the Republicans in the pivotal state Florida. As we know, Bush's margin of victory in Florida was 537 votes.

[30] Left-leaning being the Washington Post and right-leaning being the Washington Times.

experiment was a conservative leaning one.

Gentzkow and Shapiro (2010) take a quite different approach in their assessment of media bias. The methodology these authors use is to create an index by utilizing textual analysis. The index measures the similarity between the language in news stories and the rhetoric politicians in the Democratic or Republican party use. The index is composed of widely known political phrases such as “estate tax” and “war in Iraq” versus “death tax” and “war on terror”. Furthermore, they find an optimal, profit-maximizing amount of media slant and compare this with actual choices. The result implies that consumers prefer to read news that support prior political beliefs. Their findings thereby coincide with the literature that focuses on demand-driven media bias.

D’Alessio and Allen (2000) also have an empirical focus in their paper as they perform a meta-analysis. Their work summarizes 59 quantitative studies on the topic of partisan media bias in United States elections since 1948. They focus on three types of bias; gate-keeping bias, coverage bias, and statement bias. Respectively, that means checking if media outlets prefer stories about one party over another, the relative coverage, and if coverage is favorable towards one party or candidate over another. They find no evidence of an overall consistent bias in favor of either party, but many specific cases of biased news sources.

Independence between editorial content in a newspaper and the advertisers is a crucial part of journalistic ethics. Reuter and Zitzewitz (2006) address this relationship by investigating if advertising influence editors in the United States financial media. By controlling for numerous mutual fund characteristics, they can partly confirm that such a relationship exists. They examine five major United States financial news outlets. Reuter and Zitzewitz find that mutual fund recommendations are correlated with past advertisers in three personal finance magazines but not in the two national newspapers.

Turning our attention overseas, Durante and Knight (2012) investigate the supply side effect on media bias in Italy when right-wing media mogul Silvio Berlusconi's party won the national election in 2001. By using measures of on-air time for the prime minister and the opposition party leader, they document that news content on both the national television station and the television stations owned by Berlusconi moved to the right. In addition, by using survey data, they find that viewers respond to this change by modifying their consumption of news content: some of the viewers switches to more political neutral channels. This suggests that there exists a demand for less politicized information.

George and Waldfogel (2003), on the other hand, find a demand side explanation. They analyze newspaper consumption at the zip code level in 269 newspaper markets. They find that newspaper purchases by blacks increase in the size of the black community and decrease in the white community. Alternatively, white newspaper purchases increase in the size of the white community while it is unaffected by the magnitude of the black community. Their results suggest that news outlets customize their content to cater to the tastes of their main costumer group which implies that there are positive within group externalities and negative across group externalities. Interestingly, Waldfogel (2003) finds the same patterns using data from 247 U.S. radio markets.

2.5 Theoretical explanations of media bias

In order to obtain theoretical explanations for the causes of media bias, researchers often separate between supply-driven media bias and demand-driven media bias. Supply-driven media bias means that biased news stems from those who are involved in the creation of a media product. This can be media moguls, journalists, advertisers or political figures. In the literature for demand-driven media bias, on the other hand, one assumes that there is no such bias from the supply-side (Sobbrio, 2014). Instead, the bias originates from the fact that consumers have different political opinions and that the news outlets present the news with a bias to differentiate their product to complement consumer preferences. The main focus in this paper, and the basis of our model, is a demand-driven media bias.

Now, for the rest of this section, we review the most influential theoretical articles on the supply-driven media bias in the body of literature, before the focus moves towards demand-driven explanations.

2.5.1 Supply-driven media bias

According to Sobbrio (2014), supply-driven media bias can be divided into two categories; ideological bias originating from journalists and media owners or bias arising as a result of pressure from external agents like politicians, advertisers, and lobbies. A common assumption among the models of supply-driven media bias is that all consumers of news are rational and only care about learning the truth. As we will see in the next section, this differs quite substantially with the assumptions of most models analyzing the demand driven media-bias.

Baron (2006) and Anderson and McLaren (2012) are central in the literature that looks at the ideological bias coming from journalists and media owners. Baron (2006) assumes that journalists act in their own self-interest by writing stories to advance their career prospects. To achieve this, they write biased stories which increases the probability of being published. Another self-interest motive journalists act according to, Baron argues, is the wish to promote their personal political views. Thus, some journalists may slant stories to be aligned with their own political opinion. Furthermore, he presents a model in which media outlets face a trade-off between paying their journalists more and restricting journalists' discretion.[31] The reasoning behind this, is that readers always

[31]In the specification of journalist utility in the model Baron only includes the career advancement

dislike bias, so outlets want to limit bias. At the same time, low-wage journalists are more likely to write biased stories in order to advance their career prospects by gaining increased reader exposure than those with high wages. So, the media outlets risk decreasing profits because of too much bias alienating readers, but their way of limiting the bias is to pay journalists more which also decreases profits. Therefore, two effects are pulling in opposite directions and the result is ambiguous, but could result in increased media bias.

Anderson and McLaren (2012) examine media bias originating from media owners, which is implemented by hiding information. In order to model this, they assume that the owners of media outlets care about both maximizing their profits and their influence on public political opinion. Anderson and McLaren find that allowing mergers in the media market can increase the newspapers' profits, but might also reduce the amount of information transferred from newspapers to consumers. Increased hidden information by the media firms after a merger may increase the media bias. This insight is crucial for competition regulators. In the recent merger case between two Norwegian media groups, *A-Pressen* and *Edda Media* in 2012, the fact that allowing the merger possibly could reduce the political plurality in the market for news and hence impose a social cost was named one of the reasons why *A-Pressen* was required to sell several newspapers by the Norwegian competition authorities in order to get the merger approved (see entry 281 in Konkurransetilsynet, 2012).

The literature examining the bias arising from external pressure include Baron (2005), Besley and Prat (2006), Ellman and Germano (2009), Germano and Meier (2013) and Blasco, Pin, and Sobbrio (2016). Baron (2005) examines the influence of special interest groups such as lobbies on the media. He presents a model of a competition between an activist and an industry, where the goal of both groups is to influence the public opinion,

motive, while the second motive is merely pointed out. So, the journalists are described by a utility function with wages and career success based on the probability of being published.

and they do so by defending their own political positions through the news media. In the model, the media gets its information from both its own sources and journalism as well as receiving information from special interest groups. The two groups each has hard information that can either sway the bias in the medias existing journalism to be aligned with their own opinion or sway the media to be driven away from their opinion. Baron show that the information concealment by special interest groups is a possible source of media bias because only the group who has hard information that is contrary to the existing media bias will have an incentive to publish it.

The government's possible effect on media bias is examined by Besley and Prat (2006). In their model, incumbent politicians can cause a media bias by bribing the media in order to prevent them from publishing negative information about the politician. A politician will have to pay off all media outlets in order to prevent them from publishing the news because if one outlet publishes it, it will become public knowledge. Competition in the media-market can prevent this kind of media bias due to the fact that more media outlets means that it is harder (i.e. more expensive) for a politician to prevent negative news from being published.

Another important group of external agents that might influence the contents of news outlets are the advertisers who finance the outlets. This kind of external influence is in the literature referred to as *commercial media bias*. Ellman and Germano (2009) studies how advertising affects the media-market ability to provide news that is independent of the advertisers and is of high quality.[32] They model the media-market as a two-sided market where readers act rationally and value accuracy and advertisers value advert-receptive readers. Their main finding is that when the amount of advertising increase, so does the accuracy of the media outlets, even though the advertisers actually prefer

[32]The problem of news outlets that *sell* their independence to advertisers have been documented empirically. See, for example, Reuter and Zitzewitz (2006) or Chaloupka and Warner (2000) where the latter shows that large tobacco companies have been successful in pressuring United States media outlets to not report information about the health related risks of smoking.

minimal accuracy. The rationale is based on the fact that media outlets compete in Bertrand-type way for readers. Readers are a prerequisite for newspapers to sell space to advertisers, therefore, increased advertisement increases the intensity in the competition between newspapers for readers. When the competition intensifies, newspapers will be able to increase their market share by reporting news that is more accurate.[33]

In a closely related study, Germano and Meier (2013) create a model where media outlets internalize the effect of their own coverage of certain topics on the advertisers' sales and therefore their own advertisement revenues.[34] They find that when the number of media outlets increase, the accuracy of the media also increases. Germano and Meier also identifies thresholds for the number of competitors in the media-market that will provide news with no bias, intermediate bias and severe bias.

Ellman and Germano (2009) and Germano and Meier (2013) both study commercial media bias. They assume that increased accuracy by the media unambiguously reduces the revenues of the advertisers. Blasco et al. (2016) do not share this assumption. They create a model where advertisers can bribe media outlets to not disclose negative information about their product, or similarly, pay the media to publish negative information about their competitors.[35] Further, they show that increased competition not necessarily reduces the media bias. In their model, whether or not increased accuracy has a negative effect on advertisers depends on the correlation between the competitors' products. Specifically, they show that when correlation is decreasing, the accuracy of the news published is increasing.

[33]Similar to Besley and Prat (2006) and Anderson and McLaren (2012), this result also implies that increased competition in the media-market is disciplining the supply-driven media bias.

[34]That is, they study the trade-off faced by media outlets: by increasing the accuracy of their reporting they will increase their market share in the reader market, but this will however lead to a decrease in advertisement revenue.

[35]Imagine, for example, a product test of several competing products.

2.5.2 Demand-driven media bias

In describing demand-driven media bias, Sobbrio (2014) states that media bias should only arise in non-competitive media markets. His reasoning behind this statement is that if readers appreciate full accuracy and reliable information in news reporting, any bias would disappear in a competitive market (see e.g. Coase, 1974). However, it is evident that media bias does exist in competitive media markets. The reason for the observed media bias must then be that there is a a consumer demand for biased news. The papers we discuss which have a demand-driven media bias focus, are roughly separated by their assumption regarding consumer preferences. On the one hand, some papers assume consumers prefer reading news that are closer aligned with their own political preferences, while some papers assume consumers are fully rational and only care about learning the truth. Finally, as we will see, some papers discuss the possibility of combining the two.

Gabszewicz et al. (2001, 2002) investigated the diversity among newspapers in the presence of advertisers, in a simple spatial duopoly model. They assumed heterogeneity in reader preferences similar to the standard Hotelling line with length equal to one, $[0,1]$. In this interval, 0 represent the extreme leftist opinion and 1 represents the extreme opinion to the right. Gabszewicz et al. use quadratic transport costs as proposed by d'Aspremont et al. (1979) to measure disutility for readers when newspapers diverge from their political standpoint. Hence, the disutility of reading news is given by $tx_i^2 + p_i$, where x_i represents the distance from a newspaper's opinion to a reader's opinion, p_i is the price of newspaper i, and t is a measure of how intense the political opinions of a reader is. Moving over to the advertisers' side of the market, Gabszewicz et al. specifies that advertisers differ in their intensity in preferences for buying advertisement. They allow advertisers to multi-home, and examine three cases of advertiser choices: advertise in neither, advertise in both or advertise in one of them.

In their equilibrium analysis, as it turns out, Gabszewicz et al. formalize the argument of Herman and Chomsky (1988) who argued that increased dependence on advertisers would reduce the media diversity. While d'Aspremont et al. (1979) showed that a Hotelling model with quadratic transportation costs would result in maximal differentiation, Gabszewicz et al. shows that the result may be minimal differentiation, given that the advertising market is sufficiently large. Hence, they find that advertisement reduces the diversity of the media. This result is due to the two-sidedness of the news market. Advertisers want their advertisement to reach as many consumers as possible, and as newspapers are heavily relying on advertisers, they have an incentive to follow a strategy of minimal differentiation in order to attract as many consumers as possible. This, of course, leads to a fierce price competition. However, when the market for advertisements is sufficiently large, the newspapers are able to survive competition in price by selling more advertisements.[36]

An interesting extension of the model proposed by Gabszewicz et al. (2001, 2002) is found in Garcia Pires (2014). He allows newspapers to adapt to readers' political preferences. Specifically, newspapers can choose between a strategy of a single ideology and a strategy of multiple ideologies. The two possible strategies are represented by a single point on the Hotelling line and a line segment, respectively. Gabszewicz et al. found that newspapers will either choose maximal or minimal differentiation as a strategy when they can only choose a single ideology. Even though strategies of maximal differentiation imply more diversity among newspapers compared to strategies of minimal differentiation, the diversity is possibly further increased when newspapers choose a multi-ideology strategy.

In accordance with Gabszewicz et al., Garcia Pires also finds that when the advertise-

[36] Anderson and Gabszewicz (2006) extends the model by allowing for investments in quality and by adding an additional term to the readers utility functions such that readers get disutility from advertisement. This implies that advertisement imposes an additional cost to readers.

ment market is large, the newspapers choose a minimal differentiation strategy, while they choose a strategy of maximal differentiation when the advertisement market is small. Further, Garcia Pires finds that while the advertisement market is small, newspapers do not adapt to readers' preferences, while they do when the advertisement market is large. This result stems from the property that when the advertisement market is large, newspapers are not only able to finance an intense price competition, but also able to finance the additional cost of adapting news to readers' preferences.

Another interesting aspect of the perceived media bias is the possibility of vertical differentiation. Anand, Di Tella, and Galetovic (2007) create a model where media outlets observe a news event $\tilde{\theta}$, which consists of news that are verifiable and news that are not. The share of news that is verifiable in a given news event is represented by parameter $\lambda \in [0,1]$, which is common knowledge. After news outlet f observe the real news, $\tilde{\theta} \in (-\infty, \infty)$, they report θ_f. Consumers care about two things: that the news reported is aligned with their political opinion (horizontal differentiation) and about learning the real news (vertical differentiation). Consumers' ideological dispersion $\beta \in (0,1]$ form the background for their political opinion parameter $\theta_v \in (-\infty, \infty)$ uniformly distributed, similar to Hotelling's Linear City. The second part of consumer preferences is regarding the truthfulness in reporting by media outlets. First, they assume consumers' utility decreases in the distance of news report θ_f and the truth $\tilde{\theta}$. Second, utility also decreases in the distance between news report θ_f to their own political opinion θ_v. Consumers weight the two aspects with the share of verifiable news, λ: if a larger share of the news is verifiable, consumers find it more important to read news that are correct, while if more of the news is non-verifiable and possibly "opinion based", they prefer the news to be aligned with their own political opinion. Hence, Anand et al. define the utility consumer v obtains from report θ_f to be $U_{vf} = -\lambda(\theta_f - \tilde{\theta})^2 - (1-\lambda)(\theta_f - \theta_v)^2$. In other words, this specification of utility implies that consumers like to be told the truth, but they also like to be told news that confirm their views of the world.

An interesting feature of this model is that they are able to analyze a variety of situations. Sometimes, with a large share of news being verifiable, the market will resemble a classic market for information, while if the share of verifiable information is low it resembles a market for opinion. Another interesting implication is that consumers in two different markets with largely opposing beliefs on a particular news event. Then, the news outlet in each of the markets will appear to be biased to viewers in the other market.

The main takeaway from this model is however, that media bias might be caused by the fact that information is not always verifiable. Partial verifiability and heterogeneous political opinions among consumers results in the existence of a market for opinion that gives the appearance of a biased media. Furthermore, increased competition in the market for news does not limit the bias as long as this does not change the verifiability of news or the distribution of political opinions. Anand et al. shows that a prediction of their model is that if competition increase (due to lower fixed costs or increased demand), this leads to more extreme news outlets to be part of the equilibrium.

Mullainathan and Shleifer (2005) share the assumption of Anand et al. (2007) regarding consumer utility. That is, consumers value both consistency with their own political preferences and accuracy in news. Mullainathan and Shleifer present a model where consumers is interested in the true state of the world $t \sim N(0, v_t)$, while their prior political beliefs about t might be biased and are distributed $N(b, v_t)$.[37] Newspapers receive some data $d = t + \varepsilon$ about the state of the world where $\varepsilon \sim N(0, v_t)$. News outlets then make news reports with slant s such that the news report is $n = d + s$. Consumers get disutility from news that differ from their own beliefs in addition to disliking slanting away from the truth in general. Mullainathan and Shleifer specify readers' utility in a similar fashion as Anand et al., however instead of weighting the value of accuracy and consistency with their own beliefs with the verifiability of news, this preference is

[37] I.e. while the beliefs might be biased, they have the same variance as the real world.

calibrated by $\phi > 0$.[38] News outlets announce a slanting strategy $s(d)$ and decide what price they will charge before receiving the data. Consumers form expected utility of each news outlet based on $s(d)$ and price P and decide whether or not to buy the news report.

Mullainathan and Shleifer consider two cases regarding the distributions of prior beliefs, namely homogeneous and heterogeneous. Homogeneity means that all consumers have the same prior beliefs. In the heterogeneity case, their formalism of the market is similar to Hotelling's Linear City with quadratic transportation cost. The two cases are designed to capture two different types of news: The first for news where there is consensus among the consumers, and the latter for news where are substantial disagreement. Further, they measure the amount of media bias in the market as the average bias of news outlets weighted by their market share.[39]

In their equilibrium analysis, Mullainathan and Shleifer show that in the homogeneity case media bias exists even as competition increases. Increased competition leads to lower prices but common slanting among the news outlets lead towards the prior beliefs of the consumers. In the heterogeneity case, they find that news outlets segment the market and slant towards extreme positions, similar to the finding of d'Aspremont et al. (1979). Mullainathan and Shleifer point out that a consumer who crosschecks multiple news outlets might end up with unbiased posterior beliefs by *adding up* the information from each. Therefore, their main result is that reader heterogeneity is more important than competition for the accuracy in the media-market.

Gal-Or, Geylani, and Yildirim (2012) complement the work of Mullainathan and Shleifer

[38] Mullainathan and Shleifer (2005) also considers the case of rational readers who only value accuracy and show that this leads to no slanting (i.e. $s = 0$). Therefore most of their analysis focuses on the case of consumers who prefer some degree of slanting.

[39] In the homogeneous case with only one type of consumer this means that bias is simply defined as $E_d\left[(n-d)^2\right]$. In the heterogeneous case, bias is defined as $\int_i E_d\left[(n_i-d)^2\right]$ where n_i is news consumption by consumer i.

(2005) by recognizing that news outlets rely heavily on the revenues from advertisers, in addition to the subscription fees from consumers. Gal-Or et al. therefore extends the model of Mullainathan and Shleifer by modeling it as a two-sided market.

In their model, there are two news outlets and two groups of consumers where one group subscribes to one of the outlets, and the other does not subscribe to any of them. There is heterogeneity among advertisers, as they prefer reaching consumers who are more willing to purchase their product. Advertisers are uniformly distributed according to the appeal of their products, labeled α in the interval $[-\alpha, \alpha]$. Advertisers are related to political opinions through α. Higher values of α have higher appeal for consumers with political preferences more to the right, while products that are unrelated to political opinions have a value of α in the neighborhood of zero. Gal-Or et al. assume advertisers are able to multi-home, unlike consumers. Their model show that there is two opposing effects of advertisers. First, the direct effect is similar to the one found in Gabszewicz et al. (2001, 2002) as news outlets moderate the slanting in order to attract moderate consumers so that they can attract advertisers. Second, if advertisers single-home news outlets will increase the slanting in order to avoid intensified price competition in both the advertising and consumer markets. Gal-Or et al. demonstrate that when there is significant heterogeneity among advertisers in appealing to consumers with different political opinions, the indirect effect dominates, thus leading to slanting towards more extreme positions. Alternatively, when the heterogeneity is insignificant, they predict more moderate political positions by the news outlets.

Gentzkow and Shapiro (2006) provide a demand-side explanation for media bias based on the assumption that profit maximizing news outlets concerns themselves about their reputation among consumers. The news outlets are either perceived by the consumers as “high-quality” or “low-quality”. The long-term continuation profits is higher for the “high-quality” news outlets. The main difference between this model and most other demand-side models is the assumptions regarding consumer preferences. A common assumption among the articles reviewed in this section is that consumer preferences are heterogeneous and distributed along the political spectrum. In addition, consumers' utility is increasing when the reported news is closer aligned with their political preferences. This leads to horizontal differentiation with Hotelling competition among news outlets, who seek to maximize readers and profits.

Gentzkow and Shapiro (2006) depart from this assumption, as they assume that consumers are behaving rationally according to Bayesian probability and have homogeneous prior beliefs about the news. Specifically, Gentzkow and Shapiro considers a model where news outlets receive a signal about the binary state of the world (L,R).[40] The quality of the signal depends imperfectly on the *real* quality of the news outlets. A news outlet is of "high-quality" with probability λ, and of "low-quality" with probability $(1-\lambda)$. The signal received by "high-quality" news outlets is always the correct one, while probability of getting the correct signal for "low-quality" news outlets is measured by $\pi \in (\frac{1}{2},1)$, implying that the signal will have some informative value and at least not be confusing. Consumers choose action (L,R) after updating their beliefs based upon the information they receive from the news outlet and receive a payoff of 1 if their action matches that of the true state of the world, and zero otherwise. All consumers hold the same prior belief θ that the state of the world is R, and $(1-\theta)$ that the state of the world is L, where the beliefs is assumed to have some correlation with the true state of the world. Consumers make up posterior beliefs about the quality of the news outlets after observing the true state of the world with some probability, and the continuation payoff of the news outlets is increasing in consumers' posterior beliefs regarding their quality.

The model shows that the "high-quality" news outlets always will report the true state

[40] Following the notation of Gentzkow and Shapiro (2006), the two possible states of the world are *Left* or *Right*.

of the world because their signal is perfect, while the "low-quality" news outlets have an incentive to align its news reports with the prior beliefs of the consumers. This is because the posterior beliefs of being "high-quality" after reporting $\hat{r}$ is increasing in θ, and thereby causing their news reports to be biased. Further, Gentzkow and Shapiro show that competition reduces the amount of media bias because as the number of news outlets increase, so does the probability that there is a report by a "high-quality" outlet. A report by a "high-quality" outlet will expose any bias in the reporting of "low-quality" news outlets, which in turn negatively affect consumers posterior beliefs regarding their quality. Consequently, increased competition increases the incentives of "low-quality" news outlets to reveal their signal truthfully. Another important finding by Gentzkow and Shapiro (2006) is that there is a cost to media mergers related to reduced diversity and thereby limiting opposing views and fact-checking from one outlet to another.

Chan and Suen (2008) presents a spatial model for the optimal editorial positions of news outlets in which media outlets are able to influence both the political party policies and the voting behavior of consumers.[41] Similar to Gentzkow and Shapiro (2006), it is also assumed in their article that consumers are rational according to Bayesian probability. In this model, however, consumers have heterogeneous political opinions and only consume news in order to make informed choices in a political election. In addition, consumers are constrained in consuming news (e.g. limited time to read newspapers) and are only able to perceive a binary signal (l, r). News outlets perfectly observe the true state of the world $\theta \in [0, 1]$. Thus news outlets have to condensate the complex signal θ into a binary message (l, r). The editorial position of the news outlets is defined by the cut-off points decided by the editors. Each news outlet k announces their cut-off point θ_k such that if $\theta \geq \theta_k$ it will publish news report l, and if $\theta < \theta_k$ it will publish report r. Readers are aware of these cut-off points and hence also the news

[41]Chan and Suen makes use of the *Spokes model* for a differentiated oligopoly and a representation of spatial monopolistic competition derived by Chen and Riordan (2007).

outlets political position.

The model shows that consumers choose news outlets with a similar political position in a purely rational context. For example, a consumer with a left-wing political opinion will get more decision relevant information from reading the news provided by the more left-wing news outlet (and vice versa for right wing consumers).[42] This explains the presence of biased news in markets with rational consumers.

In a particularly interesting article, Xiang and Sarvary (2007) assume that there are two types of consumers: those who enjoy reading news that is consistent with their own political opinions (labeled *biased reader*), and those who only care about reading the truth (labeled *conscientious reader*). In line with Mullainathan and Shleifer (2005) and others, biased readers' preferences are uniformly distributed $x \in [a,b]$ along a political line in the style of Hotelling. These readers utility simply depends on the distance from their beliefs to the news reported, and is captured by a quadratic transportation costs $-t(x-m)^2$ in the style of d'Aspremont et al. (1979). In contrast, conscientious readers read the news in order to gain information about the truth. Their utility from reading a given news report is therefore decreasing in the deviation from the truth by the report, specified as $-k(\theta - E(\theta \mid m_i))^2$ where θ is the truth in the interval $(-\infty,\infty)$ in line with Mullainathan and Shleifer (2005) and Anand et al. (2007) and m_i is the news report by news outlet i. Xiang and Sarvary assume that conscientious readers are able to multi-home so that this group can add up the knowledge from each news report.[43] Because consumers do not observe the truth prior to reading a news report, their purchase decision is based on expected utility. The share of conscientious readers is measured by $\alpha > 0$.

[42] One can note that this is the same argument as presented by Downs (1957). Therefore, in a way, Chan and Suen further formalized his argument.

[43] If consumers choose to multi-home, their utility is specified as $-k(\theta - E(\theta \mid m_1, m_2))^2$. The assumption that consumers are able to add up the knowledge from multiple news outlets is shared by Mullainathan and Shleifer (2005).

Intuitively, one would expect that when the fraction of consumers who prefer reading unslanted news increase (i.e. an increase in α), this would lead to newspapers reducing their slanting and perhaps even present news without slant. However, in their equilibrium analysis, Xiang and Sarvary find the opposite: they find that media slanting might increase when the number of conscientious readers increase, in addition to when their dislike for slanted news is high (high k). Their result is based on the fact that conscientious readers multi-home and purchase both newspapers in order to combine the knowledge about the truth (i.e. to minimize $\theta - E(\theta \mid m_1, m_2)$). In response, in order to avoid intensifying price competition, newspapers seek to differentiate towards extreme positions. They also investigate the information efficiency for conscientious readers in such a setting and find that readers might actually get a more accurate coverage by reading multiple increasingly biased news reports than from a single news outlet that does not slant. The background for this surprising result lies in the model specification and relates to the dynamics between media outlets' data collection and reporting stance in connection with reader beliefs about the truth. Xiang and Sarvary's reasoning behind this is that when newspapers want to bias their reporting, they need to gather more information. If the data at hand is restricted, newspapers cannot report their true position any longer. The model results then show that conscientious consumers can infer the truth from the different, now bounded reports. In addition, they find that prices for news increase as the amount of conscientious readers increase.

2.6 Remarks on the literature review

The previous sections have presented some of the main research questions that have been addressed in the economic literature on differentiation, two-sided markets, multihoming and media bias. It is clear that further academic contributions are necessary to analyze these topics more deeply and to provide more empirical evidence. The two recently emerged Industrial Organization related fields of study covered in this review, two-sided markets and multi-homing, suffer from lack of empirical studies to confirm the theoretical predictions.

While the empirical literature on multi-homing is extremely scarce, there are some noteworthy empirical studies of two-sided markets.[44] We have previously cited Kaiser and Wright (2006) who presented some evidence that consumer prices are subsidized and that platforms make all their profits from the advertisers in the German market for magazine. Other recent empirical contributions on two-sided markets analyze mergers in the U.S. radio industry (Jeziorski, 2014), pricing in the U.S. cable television industry (Boik, 2016) and interchange fees on payment card services (Valverde, Chakravorti, and Fernández, 2016). Sriram et al. (2015) provide a survey of some the recent theoretical and empirical contributions to the literature on two-sided markets as well as identifying future research opportunities.

The multi-homing literature that considers endogenous location decisions by platforms is also relatively nascent. In fact, to our knowledge, Anderson et al. (2016) and Kim and Serfes (2006) are the only published papers that address this question. This is an area where more research is clearly needed. Implementing realistic assumptions into economic models is important in order improve the models' predictive powers. Such models are important, as they have implications for policy makers and competition authorities.

We have reviewed a share of the existing empirical and theoretical literature on media bias and slanting. More empirical research is needed in order to further investigate where there is a bias and how it affects society. It is also clear that there is a need for theoretical models to study the effects of recent changes in the media market. For example, it is important to investigate the effects of improved living conditions for fake

[44] We cited Kim et al. (2017) earlier. This is the only published article, to our knowledge, which empirically studies the impact of multi-homing on the consumer side.

news and media bias after the emergence of social media. Another possibility for further research is acknowledging the fact that media bias has various kinds of impact on consumers with different characteristics, and that those consumers have varying perceptions of media bias.[45] Xiang and Sarvary (2007) is one of the few existing studies that investigate the effects of varying preferences towards media bias and how this effect the market outcome.

In the next section, we expand the existing literature by proposing a multi-homing model for a two-sided newspaper market. We endogenize both the horizontal location and the vertical quality level provided by the newspapers, and analyze, in particular, where the newspapers will locate on the political spectrum.

[45]The political scientists Druckman and Parkin (2005) studies how editorial slant affect different voters, and Eveland and Shah (2003) studies the impact of individual and interpersonal factors on how consumers perceive media bias.

3 The Model

In this section, we present a simple duopoly location model using the traditional spatial model with linear transportation costs proposed by Hotelling (1929). Contrary to the assumption of Hotelling that each consumer can buy one and only one good, we allow consumers to multi-home. We share this assumption with several scholars from the present decade, however, our model is closest related to Anderson et al. (2016) and Kim and Serfes (2006), while we share the linear approach with Anderson et al. (2017) and Choi (2010). Sæberg (2012) proposes a model similar to ours in terms of using linear transportation costs, therefore, several of our calculations and results are similar to his.

When the media is accused of being biased, this involves that news outlets present the news with some form of misrepresentation. How, then, can newspapers defend publishing news with political slanting if the slanting can be disproved by facts? In our model, two premises are central. First, news reports contain varying degree of verifiable facts. More precisely, a fact can be either verifiable or nonverifiable. Nonverifiable facts admit differing interpretations of the same news event, which cannot be *proven* wrong. Any piece of news can thus be characterized by its degree of verifiability. The second premise is that consumers attitude towards reading news closer aligned with their own opinion differ according to the verifiability. When the verifiability of news is high, consumers prefer reading news of high quality. Alternatively, when the verifiability of news is low, consumers instead prefer reading news closer aligned with their existing political opinions.[46] Therefore, our model represents one of both horizontal and vertical differentiation.

[46]To define quality in news reporting, we employ the definition provided by Wyss (2002). He argues that there are two measures of quality which need to be satisfied; the ideological-normative perspective of public service and the utilitarian perspective of supplying a product that attracts the most readers and advertisers. Further, he states that these two measures often lead to conflicts of interest.

We go beyond the influential analyses of Steiner (1952) and Beebe (1977), meaning that we are more explicit about the tastes and objectives of the three primary groups of agents in the market for news.[47] The agents are the newspaper readers, the advertisement firms, and the newspapers, which represents the platforms and are coordinating the two sides of the market. We describe each group of agents' preferences and objectives in turn.

3.1 Reader preferences

We assume that readers care about two things, how close the news are to their own existing opinions and the quality of the news reported. There is a continuum of readers of mass 1 with an opinion parameter x uniformly distributed on the Hotelling line, in the interval $[0,1]$. Consumers prefer reading news closer aligned with their own political opinion. More precisely, the utility achieved by a consumer located at point x from reading a newspaper falls with the political distance to the newspaper. For example, the utility of reading a news report from a newspaper located at z_1 falls with distance $(x-z_1)$. Distance z_1 is the distance from the far left, 0, to the left-most newspaper, while z_2 is the distance from the far right, 1, to the right-most newspaper. Figure 6 is a reminder of Figure 3 and illustrates the locations of the newspapers and distances with respect to a consumer located at x. The second part of readers' preferences regards the quality q_i in the news reported, for example, they enjoy reading news stories written by highly skilled journalists who covers topics precisely and accurately.

A newspaper reader puts relative weights on the two components according to a parameter $\lambda \in [0,1]$ of verifiable facts. For example, a news report with $\lambda = 0$ might be an

[47] Steiner assumed that each consumer would only accept his highest priority program, and defined consumer preferences as exclusive: "preferences for any given program type are exclusive - that is, in each case non-listening is the second choice of an individual" (Steiner, 1952, p. 199). Beebe analyses the situation where consumers may accept the second priority program.

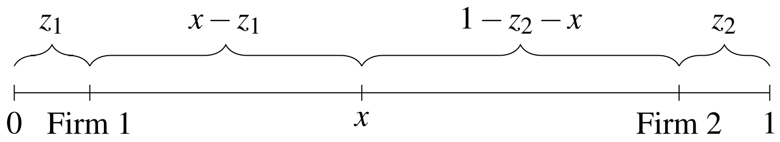

Figure 6: Locations of newspapers

editorial which simply represents the opinion of the newspaper as one cannot dispute the accuracy of that opinion. A fully verifiable news report with $\lambda = 1$ might be the results of a sporting event or the outcome of a political election. In the second case, the news reported are easily verifiable. One can note that if $\lambda = 0$, this represents a game of only horizontal differentiation, as the vertical aspect of the model disappears. This special case is studied in section 4.1, while we for the rest of the analysis limit ourselves to intermediate values of λ.

We assume that readers do not incur any nuisance cost of advertisements. This is consistent with the empirical evidence by Kaiser and Song (2009). As a consequence, the price incurred by a consumer by buying a newspaper is the monetary value p_i for $i = 1,2$ and the transportation cost.[48] A given reader value reading a newspaper equal to v, which represents her reservation utility. The net utility is decreasing in the distance between her own opinion and that of the newspaper, and the price she must pay in order to buy the newspaper. In order to allow for a newspaper's consumers to be located on both sides of its own position we have to specify the utility functions using absolute differences, a formulation we share with Sæberg (2012). The net utility is further increasing in the newspapers level of quality. We draw a measure of quality q_i for $i = 1,2$ from models of vertical differentiation (e.g. Gabszewicz and Thisse, 1979; Mussa and Rosen, 1978; Shaked and Sutton, 1982).[49] Hence, the utility a reader with opinion x obtains from

[48] This is not shared by all scholars. In the models of Anderson and Coate (2005) and Kind et al. (2007, 2009) it is in fact included an addition cost term for nuisance. In the multi-homing model proposed by Anderson et al. (2016) the platforms are entirely financed by advertising, and consumers can either like, dislike or be indifferent towards advertisement.

[49] Recall that Anderson et al. (2017) specified consumers incremental utility of increased quality to de-

reading a news report from newspaper 1 is

$$u_1^R = v - (1-\lambda) \mid x - z_1 \mid + \lambda q_1 - p_1, \tag{3.1}$$

while the utility obtained from newspaper 2 is

$$u_2^R = v - (1-\lambda) \mid (1-z_2) - x \mid + \lambda q_2 - p_2, \tag{3.2}$$

where z_1 and $1-z_2$ represents the locations of newspaper 1 and 2 from the far left, respectively. We share with a large number of academics the assumption that consumers prefer reading news that is closer aligned with their own opinion (e.g. Gabszewicz et al., 2001, 2002; Gal-Or et al., 2012; Mullainathan and Shleifer, 2005). This is well documented empirically. For example, in an experimental study, Bartlett and Burt (1933) show that people remember such stories better. Teigen (1985), in another experimental study, found that people prefer reading news concerning about topics they are more familiar with. Recall Figure 1, which showed that consumers tend to prefer news outlets, which have traditionally been considered to have political affiliation according to their own political preference.

We share the assumption that consumers place more value on the quality of news when the verifiability is high with Anand et al. (2007). Anand et al. cites research by Lord, Ross, and Lepper (1979) and Rabin and Schrag (1999) who document a "confirmatory bias" which shows that people often interpret data with ambiguous conclusions as evidence of their prior beliefs.[50] A main point of our model is that the relative weights readers place on the quality of news and reading news aligned with their own opinion is

crease in the share of overlapping functionality of the products. While they exemplified this specification with the market for tablets, it does not make much sense to include this assumption in a model of the media market.

[50]See Nickerson (1998) for a general review of evidence of a "confirmation bias".

determined by the share of verifiable facts on which a news report is based on. This formulation means that consumers only value the ideological aspects of news when reading news that is not fully verifiable, while when the news are fully verifiable, they only care about the quality of the news report.

Although we are inspired by Anand et al. in the formulation of readers preferences, there are three key differences between their model and ours. First, both our model and Anand et al.'s model employ the verifiability measure λ. Both models also consider the newspapers alignment with readers' political views. We consider the quality of news weighted by the share of verifiable news. Anand et al. instead considers the trade-off faced by newspapers in aligning news with readers' opinions simultaneously as striving to maintain truthfulness in reporting. Second, Anand et al. does not allow consumers to purchase both newspapers, while we do. Third, Anand et al. uses quadratic transportation costs in the style of d'Aspremont et al. (1979), while we use linear as originally formulated by Hotelling (1929).

In our model, we allow consumers to buy both newspaper, and thereby engage in multi-homing. A consumer who buys both newspaper has to "travel" to both newspapers in order to buy them and thereby incur two transportation costs. Similarly, he can also enjoy the double satisfaction of the quality provided by the newspapers. The fact consumers often buy several products, implies that they have some preference for variety (Kim and Serfes, 2006). Sajeesh and Raju (2010) defined variety seeking as "a relative reduction in the willingness to pay of the previously purchased brand" (Sajeesh and Raju, 2010, p. 949). Following the custom in the field, the consumer will incur some reduction of the value by reading the second newspaper as long as the two newspaper is somewhat overlapping content wise. Similar to the formulation of Choi (2010), we assume the reduction in utility is measured by parameter $\sigma \in [0,1]$, such that a consumer will enjoy additional utility $\sigma v \leq v$ from reading a second newspaper.[51] Consequently,

[51] This formulation corresponds to λb in Choi (2010), where b is the valuation a consumer places on

a reader who engages in multi-homing and buys both newspapers obtains utility

$$u^R_{12} = (1+\sigma)v - (1-\lambda)(\mid x-a \mid + \mid (1-b)-x \mid) + \lambda\,(q_1+q_2) - p_1 - p_2. \quad (3.3)$$

Spatial models are notoriously known for their stability issues. Recall from the review of the differentiation literature that the existence of equilibria generally depends on the model specifications, such as the nature of the transportation costs (d'Aspremont et al., 1979; Economides, 1986) or the availability of outside options (Böckem, 1994). Anderson et al. (2016) and Kim and Serfes (2006) have shown that by adding the possibility of multi-homing consumers one might find stable location equilibria. d'Aspremont et al. showed that there are no equilibria when using linear transportation costs. Naturally, in order to find an equilibrium in this model, we must require that there indeed are multi-homing consumers. We will return to this assumption after we have formalized the consumer demand functions.

3.2 Advertisers

Modelling advertisers in media models of two-sided markets can be done in multiple ways. Gal-Or et al. (2012) assume heterogeneity among advertisers who are distributed along the same political line as consumers, and therefore prefer to reach consumers closer to their own location as these consumers are more receptive to their products. In Ellman and Germano (2009), consumers differ in how much they dislike advertisement and consequently, advertisers target the newspapers with the mass of readers who is

consuming a good while λ is the additional utility from the second good due to overlapping features of the two goods. This formulation is also close to Kim and Serfes (2006) who assume the utility of buying a first good is equal θ, and the incremental utility of buying a second good is equal to $\alpha < \theta$ such that the consumer place value $\theta + \alpha$ on buying both goods.

most most receptive to advertisement.[52] In this model, however, we follow Gabszewicz et al. (2001, 2002) closely in terms of advertisers. We assume that the demand for advertisement is perfect elastic. This means that advertisement demand is flat, so that there is no ad level decision to be made by the newspapers or any advertiser surplus to worry about.[53] Other authors also using a perfectly elastic demand include Spence and Owen (1977) and Hansen and Kyhl (2001), while Peitz and Valletti (2008) use imperfect elastic advertisement demand.

We follow the assumption of Gabszewicz et al. (2001, 2002) that advertisers differ in their taste for advertisement, implying that there is heterogeneity in the intensity of preferences θ among advertisers. Namely, an advertiser is represented by $\theta \in [0,1]$. We assume, like Gabszewicz et al., that an advertiser's valuation of advertising in newspaper i is given by the product of the intensity of preferences θ and the number of readers in newspaper i, labeled D_i. Advertisements are bought by advertisers at tariffs s_i, from newspaper i. It follows that the net utility of buying an advertisement in newspaper i for advertiser of type θ is given by

$$u_i^A = \theta D_i - s_i. \tag{3.4}$$

In addition, we do as Gabszewicz et al. (2001, 2002) and assume that the density of advertisers of type θ is constant and equal to $4k$, so that k represents the population size of advertisers.[54] Thus, the larger k, the larger advertisement revenues for the newspapers.

[52] A comprehensive survey of the economics of advertisement is provided in Bagwell (2007). Anderson and Jullien (2015) provides a updated survey of the advertisement financed business models in two-sided media markets.

[53] Gabszewicz et al. (2001, 2002) allowed advertisers to advertise in both newspapers, and hence engage in multi-homing. Since both they and us use perfect elastic demand for advertisement, this does not affect the market outcome. For simplicity, we restrain advertisers possibilities to multi-home.

[54] The choice of exactly $4k$ as population size is due to simplicity of calculations, as will be evident in the equilibrium analysis.

3.3 Newspapers

Newspapers get their revenues from two sources, by selling newspapers to consumers and from selling advertisement to advertisers. From consumers they receive price p_i per copy sold while they incur marginal cost c of selling one newspaper. We assume away any marginal cost of an additional advertisement inset. The marginal profit of a newspaper times the total consumer demand is hence the revenue accruing from consumers. By selling advertisement, they receive a tariff s_i per advertisement sold, times the demand for advertisement A_i. When newspaper invest in quality, they incur investment costs given by a function $C(q_i) \geq 0$, with $C'(q_i) > 0$ and $C''(q_i) > 0$. We draw the properties of the cost function from Anderson et al. (2017), who assume that the cost function is sufficiently convex to ensure the existence of a stable, symmetric equilibrium. A possible form of $C(q_i)$ which satisfies these criteria is ϕq_i^2, where ϕ is the cost of a marginal increase in quality q_i.[55] We will therefore use this as the form of the cost function in the analysis part. The profit of newspaper i is hence given by

$$\Pi_i = D_i(p_i - c) + s_i A_i - C(q_i),\ C(q_i) = \phi q_i^2. \tag{3.5}$$

Recall that the left-most newspaper is located distance z_1 from the far left while the right-most is located distance z_2 from the far right. This formulation implies, without loss of generality, that the left-most newspaper (newspaper 1) is located weakly to the left of the right-most (newspaper 2). Formally, this means that $z_1 \leq 1 - z_2$ is always satisfied.

[55] As will be evident in the equilibrium analysis, we must also require that ϕ is sufficiently high $\left(\phi > \lambda^2/(4-4\lambda)\right)$ in order to ensure the existence of a stable equilibrium.

3.4 Timeline

We consider a four-stage game completed in the following order:

1. Newspapers choose an opinion. Newspaper 1 choose opinion z_1 while newspaper 2 choose opinion z_2.
2. Newspaper i determines the level of quality q_i and completes the required investments.
3. In the third stage, newspaper i choose prices p_i to be charged by the consumers.
4. In the fourth stage, advertising tariffs s_i are determined.

4 Equilibrium analysis

We begin by separating our analysis into two cases. In the first case, we characterize an equilibrium when readers of newspapers do not value the quality of newspapers. This is a useful benchmark because, as it turns out, the equilibrium locations when readers do value quality are equal. In the second case, we calculate the equilibrium outcome when readers do value quality. This modification does, however, cause some minor alterations in the analysis. Most importantly, because readers do not care about quality in the first case, we transform the game into a three-stage game by excluding the quality stage.

4.1 Equilibrium when readers do not care about quality

In this section, we solve the model under the assumption that readers do not care about the quality of the news reported. This means that the newspapers are competing solely in the market for opinions, as this is the only consideration taken by newspapers concerning the content of the news reports. Assuming that readers place no value on the quality of news implies an adjustment of reader preferences such that the verifiability parameter λ is taken out of the model. When relaxing the assumption of an intermediate verifiability parameter, our model simplifies to one of only horizontal differentiation as the vertical aspect disappears. In order for the model to still give us insight about how consumer preferences towards reading news that is aligned with their own opinion affect the equilibria, we propose a slight adjustment of the model assumptions and use a measure for the intensity of preferences t instead of $(1-\lambda)$. That is, t represents a measure of how intense the political preferences of the consumers are. The transportation cost incurred by consumers when reading news that is not perfectly aligned with their own opinions is hence the product of t and the distance "traveled".

As consumers do not value investments in quality by the newspapers, we see that the equilibrium quality levels q_i are zero.[56] As a result, we do not consider the quality game in the second stage. Therefore, the game now consists of the following three subgames played by the newspaper editors. In the first stage, the editors choose opinions z_1 and z_2. In the second stage, the editors choose prices p_i. In the third stage, the advertisement tariffs s_i are determined.

The Advertisement Game

The game is solved by backward induction. Therefore, we start with the third stage. In the last stage of the game, the equilibrium locations z_i, and prices p_i has already been decided in preceding stages. By using Equation (3.4), we can find the location of the indifferent advertiser. The advertiser who is indifferent between advertising or not is located such that

$$u_i^A = 0 \Leftrightarrow \theta = \frac{s_i}{D_i}. \tag{4.1}$$

Recalling that the density of advertisers is equal $4k$, this implies that the demand for advertisement at newspaper i is given by

$$A_i = 4k\left(1 - \frac{s_i}{D_i}\right) \text{ for } i = 1, 2 \tag{4.2}$$

which is illustrated in Figure 7.[57] The demand for advertising in newspaper i does

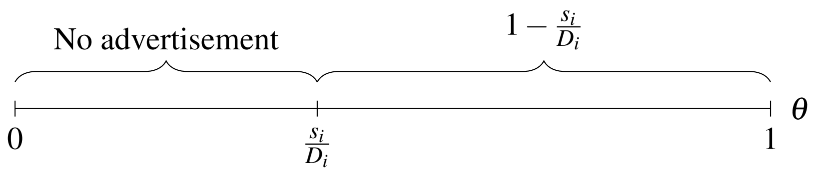

Figure 7: Demand for advertisement

[56] From Equation (3.5), we see that by solving $\partial \Pi_i / \partial q_i = -2\phi q_i = 0$ for q_i, implies that $q_i = 0$.

not depend on the tariff of the competing newspaper s_j. This property is due to our assumption of perfect elastic demand for advertisement. That the demand faced by each newspaper is independent of the other implies that the game between the newspapers on the advertising market is "degenerate": Each newspaper i behaves as a monopolist and independently chooses its tariff s_i by maximizing advertisement revenues R_i, which is the product of demand and tariff:

$$\underset{s_i}{\text{maximize}} \quad R_i = s_i A_i = 4k\left(1 - \frac{s_i}{D_i}\right) s_i$$

Solving this problem with the first order condition, $\partial R_i / \partial s_i = 0$, yields the equilibrium tariffs

$$s_i^* = \frac{D_i}{2} \tag{4.3}$$

and equilibrium revenues are found by substituting the optimal tariffs back into the advertising revenue function, R_i:

$$R_i^* = D_i k. \tag{4.4}$$

The second order condition for a maximum is easily verified,

$$\frac{\partial^2 R_i}{\partial s_i^2} = -\frac{8k}{D_i} < 0.$$

The advertisement tariffs and revenue increases in the demand for a given newspaper $(\partial s_i / \partial D_i > 0)$. This is mathematically inherited from the advertisers' utility function. As newspaper demand D_i increase, the advertisers' valuation of advertisement in newspaper i also increase. Additionally, it is worth noting, as done by Gabszewicz et al. (2001, 2002), that the results in the preceding stages would be unaffected if the advertisement rate per costumer were set exogenously at rate k per costumer.

[57] All advertisers located left of $\frac{s_i}{D_i}$, i.e. $\theta \in \left[0, \frac{s_i}{D_i}\right]$, will choose not to advertise, while those on the right side, i.e. $\theta \in \left[\frac{s_i}{D_i}, 1\right]$, will advertise.

The Price Game

The price game is played in the second stage. In order to derive the optimal prices, we first need to calculate the demand functions faced by the newspaper contingent on the prices. Because readers in this case do not care about quality, we disregard the expression $1-\lambda$, and the consumers' utility functions are slightly rewritten. By using $\lambda = 0$ and substituting $(1-\lambda)$ with t, we can rewrite the utility functions from Equations (3.1), (3.2) and (3.3) as

$$u_1^R = v - t \mid x - z_1 \mid - p_1, \tag{4.5}$$

$$u_2^R = v - t \mid (1-z_2) - x \mid - p_2 \text{ and} \tag{4.6}$$

$$u_{12}^R = (1+\sigma)v - t(\mid x - z_1 \mid + \mid (1-z_2) - x \mid) - p_1 - p_2. \tag{4.7}$$

First, we find the consumer who is indifferent between buying newspaper 1 and buying both, using Equations (4.5) and (4.7):

$$\begin{aligned} u_1^R &= u_{12}^R \\ \sigma v - t \mid (1-z_2) - x \mid &= p_2 \\ x_{12} &= (1-z_2) - \frac{\sigma v - p_2}{t} \end{aligned} \tag{4.8}$$

Second, we find the consumer who is indifferent between buying newspaper 2 and both using Equations (4.6) and (4.7):

$$\begin{aligned} u_2^R &= u_{12}^R \\ \sigma v - t \mid z_1 - x \mid &= p_1 \\ x_{21} &= z_2 + \frac{\sigma v - p_1}{t} \end{aligned} \tag{4.9}$$

In order to make sure that our solution is feasible, we impose several restrictions on the allowed locations of the firms and the consumers. First, we assume that the newspapers cannot locate outside the Hotelling line as is commonly done in the related literature. Formally, this translates to assuming $z_1 \geq 0$ and $1 - z_2 \leq 1$. For further discussion on this possibility, see for example Tabuchi and Thisse (1995) and Kind, Schjelderup, and Stähler (2013) who examine such equilibria. Second, we can immediately rule out the possibility that $(1 - z_2) - x_{12} < 0$ and $x_{21} - z_1 < 0$ as this would imply that newspaper 1 would locate itself to the right of its customers and for newspaper 2 to locate itself to the left of its customers.

Third, a set of locations that can also be immediately ruled out as possible Nash equilibria are combinations of z_1 and z_2 that makes one utility curve lie strictly above the other so that the lower newspaper has no customers (i.e. $u_i^R > u_j^R \ \vee \ u_j^R > u_i^R \ \forall \ i, j$). In such a case, the lower newspaper would clearly have an incentive to change its location in order to attract customers. Formally, that means that we require that the utility functions to intersect at some point along the line. This is the location of the indifferent customer in the single-homing case. Recalling that $z_1 \leq 1 - z_2$ is always satisfied, we can find the intersection by setting the two single-homing utility functions from Equations (4.5) and (4.6) equal to each other:

$$\begin{aligned}
u_1^R &= u_2^R \\
v - t \mid x - z_1 \mid - p_1 &= v - t \mid (1 - z_2) - x \mid - p_2 \\
\mid (1 - z_2) - x \mid - \mid x - z_1 \mid &= \frac{p_2 - p_1}{2} \\
\hat{x} &= \frac{1 + z_1 - z_2}{2} + \frac{p_1 - p_2}{2t}
\end{aligned} \tag{4.10}$$

We will revisit the intersection when evaluating the solution of the opinion game in the first stage. Having established some restrictions on the locations of the newspapers, we turn our attention to the consumers. First, we require that both indifferent consumers lie within the Hotelling line. Formally, this means that we require $x_{12} > 0$ and $x_{21} < 1$. These restrictions have an intuitive implication, namely that no newspaper covers the entire market (i.e. $D_1 < 1$ and $D_2 < 1$). By requiring that no newspaper covers the entire market, we assume that some consumers buy only newspaper 1, some buy only newspaper 2 and some buy both. Substituting Equations (4.8) and (4.9) into the inequalities yields the following restrictions:

$$\begin{aligned} \sigma v &< p_1 + t(1 - z_1) \\ \sigma v &< p_2 + t(1 - z_2) \end{aligned} \tag{4.11}$$

These restrictions ensure that the incremental utility of buying the second newspaper σ is sufficiently low such that at a minimum the farthest away consumer will incur a net disutility by buying a second newspaper. Without this restriction, all consumers would have been able to multi-home.

As noted in section 2.1, and shown by d'Aspremont et al. (1979), a Hotelling model with linear transportation costs, such as ours, breaks down under single-homing. Kim and Serfes (2006) showed that under multi-homing there exists equilibrium locations provided that the incremental utility of buying a second newspaper is sufficiently high. Therefore, in the following we require that there is at least some consumers who engage in multi-homing. Using Equations (4.8) and (4.9), we require that

$$\begin{aligned} x_{12} &< x_{21} \\ (1 - z_2) - \frac{\sigma v - p_2}{t} &< z_1 + \frac{\sigma v - p_1}{t} \\ \sigma v &> \frac{p_1 + p_2}{2} + \frac{t(1 - z_1 - z_2)}{2} \end{aligned} \tag{4.12}$$

Table 1 sums up the conditions on consumers required for multi-homing. We see that a equilibrium is contingent on the valuation of the second newspaper, σv, being in the interval specified by the restrictions.

Requirement	Constraint	Condition	Implication
Some buy both newspapers	$x_{12} < x_{21}$	$\sigma v > \frac{1}{2}(p_1 + p_2) + \frac{1}{2}t(1 - z_1 - z_2)$	$D_1 + D_2 > 1$
Not all buy newspaper 1	$x_{12} > 0$	$\sigma v < p_1 + t(1 - z_1)$	$D_1 < 1$
Not all buy newspaper 2	$x_{21} < 1$	$\sigma v < p_2 + t(1 - z_2)$	$D_2 < 1$

Table 1: Consumer restrictions in the first iteration

The demands are on the form $D_1 = x_{21}$ and $D_2 = 1 - x_{12}$. By generalizing for $i = 1, 2$, the demands faced by the two newspapers can be written as

$$D_i = z_i + \frac{\sigma v - p_i}{t}. \tag{4.13}$$

In the second stage, the equilibrium locations z_i has already been decided in the first stage. Using the equilibrium advertisement revenue, Equation (4.4), from the third stage, we can rewrite the platforms profit functions:

$$\begin{aligned}\Pi_i &= D_i(p_i - c) + s_i A_i \\ &= D_i(p_i - c) + D_i k \\ &= D_i(p_i + k - c)\end{aligned} \tag{4.14}$$

where Equation (4.14) implies that k is the per copy subsidy paid by advertisers. The newspapers maximize their profits with respect to the price charged to the consumers. We find the equilibrium prices with the first order condition:

$$\begin{aligned}\frac{d\Pi_i}{dp_i} &= \frac{\partial \Pi_i}{\partial p_i} + \frac{\partial \Pi_i}{\partial D_i}\frac{dD_i}{dp_i} = 0 \\ z_i &+ \frac{\sigma v - 2p_i - k + c}{t} = 0 \\ p_i^* &= \frac{tz_i - k + \sigma v + c}{2}, t \neq 0\end{aligned} \tag{4.15}$$

The second order condition for a maximum is easily verified,

$$\frac{\partial^2 \Pi_i}{\partial p_i^2} = -\frac{2}{t} < 0.$$

These equilibrium prices are the solution to the second stage of the game. We see that prices increase as firms move closer to the center $(\partial p_i / \partial z_i > 0)$, while prices decrease in the amount of advertisers $(\partial p_i / \partial k < 0)$. The latter result is due to the two-sidedness of the market for newspapers. Intuitively, this means that as the amount of advertisers increase, newspapers will lower their prices to consumers in order to attract more consumers, which in turn attracts more advertisers. In order to clearly see the intuition, recall that the advertisers demand for advertisement is increasing in the demand faced from consumers by a given newspapers. Formally, from advertisers demand in Equation (4.2) we see that this is increasing in D_i $(\partial A_i / \partial D_i > 0)$, while consumer demand is decreasing in prices $(\partial D_i / \partial p_i < 0)$ from Equation (4.13).

The locations of the indifferent consumers when newspapers have interior locations are illustrated in Figure 8, which is adopted from Anderson et al. (2016, p. 14). Note that t is the slope of the utility curve for single homing consumers, while σt is the slope of the utility curve for consumers buying a second good.

The Opinion Game

In the first stage of the game, we derive the equilibrium locations of the newspapers. First, we find the equilibrium demands using the equilibrium prices derived in the sec-

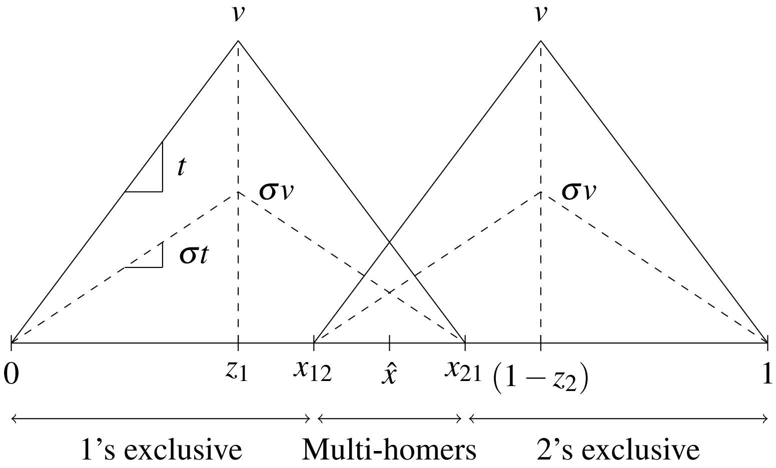

Figure 8: Multi-homing consumers

ond stage. We substitute Equation (4.15) into (4.13):

$$
\begin{aligned}
D_i &= z_i + \frac{\sigma v}{t} - \frac{t z_i - k + \sigma v + c}{2t} \\
&= \frac{z_i(2-t) + \sigma v + k - c}{4}
\end{aligned}
\tag{4.16}
$$

We see that the demand for each newspaper is increasing in the number of advertisers $(\partial D_i/\partial k > 0)$. We find that the sign of the partial derivative with respect to location is depending on the size of the transportation cost t. Namely,

$$
\frac{\partial D_i}{\partial z_i}
\begin{cases}
\geq 0, & \text{if } t \leq 2 \\
< 0, & \text{if } t > 2.
\end{cases}
$$

In order to interpret this result, we make use of the observation that demand is decreasing in t $(\partial D_i/\partial t < 0)$. This is the effect Kim and Serfes (2006) identified as the *aggregate demand creation effect*. In our model it translates into the fact that as the transportation cost decreases, each newspaper is able to reach further into the Hotelling line of consumers, as more consumers will be willing to buy both newspapers. Going back to the partial derivative of the demand function with respect to the opinions z_i we see that the aggregate demand creation effect is only present as long as t is sufficiently low ($t \leq 2$). We will shortly return to this possible problem and examine the case of $t > 2$.

Second, we complete the profit function by substituting Equations (4.15) and (4.16) into (4.14):

$$\begin{aligned}\Pi_i &= \frac{z_i(2-t)+\sigma v+k-c}{4}\left(\frac{tz_i-k+\sigma v+c}{2}+k-c\right)\\ &= \frac{(tz_i+k+\sigma v-c)(2z_i-2t+\sigma v+k-c)}{2}\end{aligned} \tag{4.17}$$

Remarkably, we find that newspaper i's profits are independent of the competitors' choice of location, z_j. This implies that the location choice of newspaper i is independent of newspapers j's choice. The fact that each newspapers location choice is independent of the competitors' means that the newspapers choose their locations as if they were monopolists. We know from Anderson et al. (2016) that this is because the multi-homing problem has reduced to a monopoly problem. This is because when firms attract additional multi-homers, these consumers do not stop buying the competing newspaper, instead they buy both. As a result, the location choice of each newspaper is independent of the other.

By making use of the intersections of the single-homing utility curves derived in Equation (4.10), we can establish the possible combinations of z_1 and z_2. As we know that $z_1 \leq 1-z_2$ is always satisfied, this also implies that the intersection of the utility curves is located somewhere between the two newspapers, i.e. $z_1 \leq \hat{x} \leq 1-z_2$. By substituting the prices from Equation (4.15) into (4.10), we see that the locations must satisfy $z_1 \leq (3z_1-3z_2+2)/4 \leq 1-z_2$. Simplifying the inequality yields restrictions $z_1 \leq 2-3z_2$ and $z_2 \leq 2-3z_1$. The possible combinations of z_1 and z_2 is illustrated in

Figure 9, with the additional restriction that $z_1 + z_2 \leq 1$.

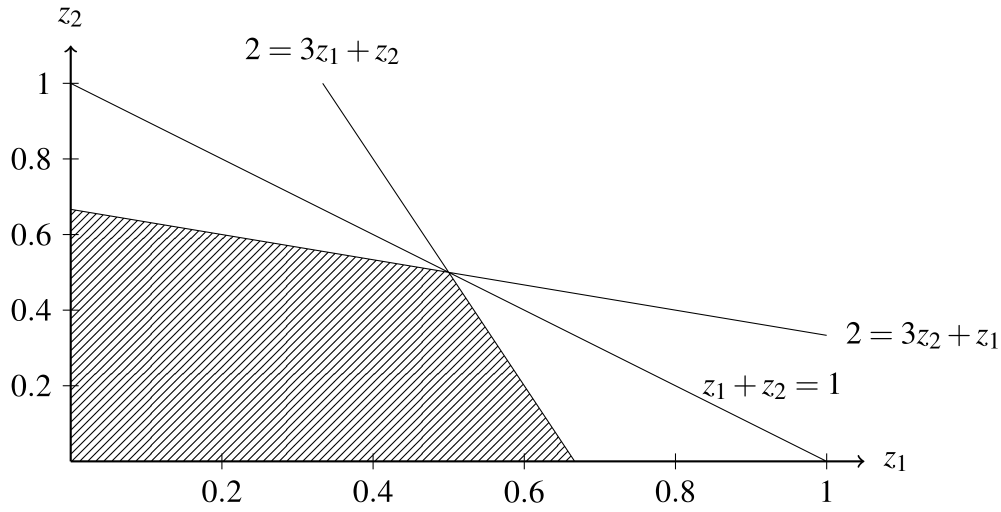

Figure 9: Possible combinations of z_1 and z_2

Recalling the restrictions imposed in Equations (4.11) and (4.12) (and summarized in Table 1), by substituting for p_i in Equation (4.15), these can be rewritten as

$$\sigma v < c - k - t(z_1 - 2) \wedge \sigma v < c - k - t(z_2 - 2) \text{ and} \tag{4.18}$$

$$\sigma v > c - k - \frac{t(z_1 + z_2 - 2)}{2}, \tag{4.19}$$

respectively. Now, we can search for the newspapers' equilibrium opinions. The sign of the first derivative tells us what direction the firms will move to in order to increase their profits. A negative first derivative implies that the firms' profit from moving further away, i.e. to the end of line locations $(z_1, z_2) = (0, 0)$. A positive derivative, on the other hand, implies that the firms will gather at the center, i.e. at the middle locations $(z_1, z_2) = (1/2, 1/2)$. Note that as the firms moves symmetrically closer towards the center, they stop halfway and do not move the entire way over to the other side. This is due to the formulation of the model. Recall that newspaper 1 is the label of the left-most and newspaper 2 is the label for the right-most newspaper. Suppose that the newspapers move slightly over the mid-point of the line. Due to the formulation of the model, the newspapers now switch notation. The same effect that pushed the newspaper towards the center will still be in effect, and will now push it back. Mathematically, the two newspapers have now switched their notation and the specification of the right-most and the left-most firm becomes opposite of the starting point. From Figure 9, minimal differentiation represents the point where all constraints are binding.

We find that the first derivative is positive for certain values of t, by total differentiating Equation (4.14):

$$\frac{d\Pi_i}{dz_i} = \overbrace{\frac{\partial \Pi_i}{\partial z_i}}^{=0} + \underbrace{\overbrace{\frac{\partial \Pi_i}{\partial D_i}}^{(p_i+k-c)} \times \overbrace{\frac{dD_i}{dz_i}}^{\geq 0 \text{ if } t \leq 2}}_{\text{Demand effect}} + \underbrace{\overbrace{\frac{\partial \Pi_i}{\partial p_i}}^{>0} \times \overbrace{\frac{dp_i}{dz_i}}^{>0}}_{\text{Price effect}}$$

As we see, this is positive as long as $(p_i + k - c) > 0$, i.e. that newspapers are sold with a positive profit margin, and that the transportation cost is sufficiently low, $t \leq 2$.[58] Therefore, we will have to consider two cases: $t \leq 2$ and $t > 2$. We will next investigate if there are any Nash equilibria for $t \leq 2$ in the first case, and then consider $t > 2$ in the second case.

Case 1: Minimal differentiation $(t \leq 2)$**.**
The first case translates to $d\Pi_i/dz_i > 0$. This suggests that there exists a Nash equilibrium with minimal differentiation where both newspapers locate in the middle $(z_i = 1/2)$. In order to explain why minimal differentiation is a Nash equilibrium when newspaper profit is increasing in distance z_i we consider new-found insights from Kim and Serfes (2006) and Anderson et al. (2016). This result is the same as Hotelling's Principle of Minimal Differentiation that was called into question, and shown to be wrong by d'Aspremont et al. (1979). However, Hotelling and d'Aspremont et al. only considered

[58] $p_i + k - c > 0$ implies $\sigma v > c - k - tz_i$ after substituting from Equation (4.15) and is covered by restriction (4.19).

single-homing in their analyses.

We know that even after a tariff or price deviation there will still be some consumers who buy both newspapers. Neither firm will have any incentive to deviate in either the third or second stage because both the first- and second order conditions are satisfied. We require there to be multi-homing consumers in order to be able to identify a equilibrium in Equation (4.18). Hence, no deviations in prices or tariffs are profitable. As long as the first derivative $d\Pi_i/dz_i > 0$ is satisfied, we know that both newspapers will locate in the middle. The result is hence minimal differentiation. We have therefore established our first proposition, which also is illustrated in Figure 10:

Proposition 1 *Minimal differentiation,* $(z_1, z_2) = (1/2, 1/2)$*, is a Nash equilibrium in a covered market where some consumers multi-home and the transportation cost is sufficiently low* $(t \leq 2)$.

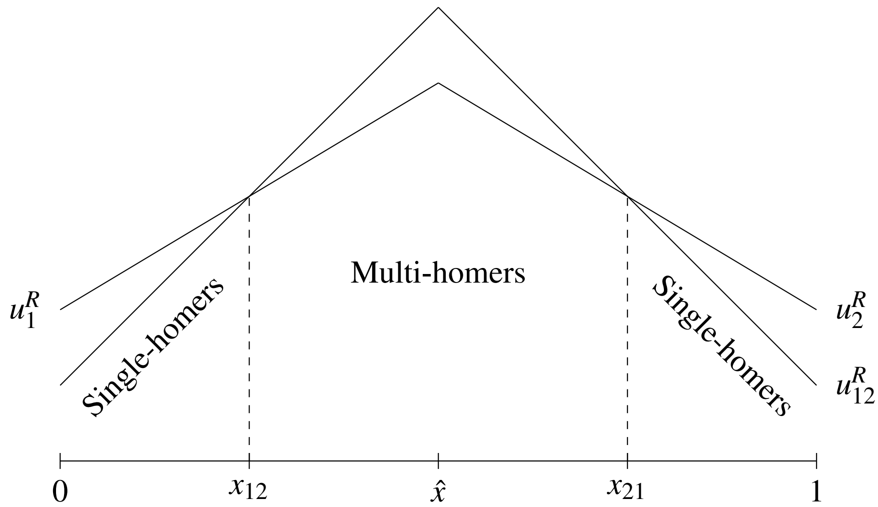

Figure 10: Indirect utility of multi-homing with minimal differentiation

The prices and profits, after substituting $(z_1, z_2) = (1/2, 1/2)$ into Equations (4.15) and

(4.17), are given by

$$p_i^{min} = \frac{0.5t - k + \sigma v + c}{2} \text{ and} \tag{4.20}$$

$$\Pi_i^{min} = \frac{(0.5t + k + \sigma v - c)(1 - 2t + \sigma v + k - c)}{2}. \tag{4.21}$$

Case 2: Maximal differentiation $(t > 2)$**.**

While we could easily see that the first derivative is positive in the case of $t \leq 2$, this is not so straightforward for the second case. We know that the demand effect will be negative, while the price effect is positive. However, for the first derivative to be negative and thereby causing maximum differentiation we need the demand effect to be larger than the price effect. This implies that the following expression must be satisfied:

$$\left(\frac{tz_i - k + \sigma v + c}{2} + k - c\right)\frac{2-t}{4} > \frac{t(z_i(2-t) + \sigma v + k - c)}{8}$$

$$\sigma v < c - k$$

Considering restriction (4.19), which in the maximal differentiation case translates into $\sigma v > c - k + t$ after substituting in $(z_1, z_2) = (0, 0)$, we see that these are incompatible. Therefore, there are no Nash equilibria with $t > 2$. That is, when transportation costs surpass a certain threshold, consumers do not multi-home and no stable equilibrium exists such as d'Aspremont et al. (1979) showed.

4.2 Equilibrium when readers value quality

For this analysis, we impose a small change to the profit functions. Namely, we assume that the marginal cost c is constant and equal to zero, for simplicity of calculations. On a different note, we know that the equilibrium tariffs and advertisement revenue derived in the previous section is unaffected by a change in consumer preferences. Therefore, we skip the calculations in the fourth stage and simply refer to the equilibrium tariffs (4.3) and revenues (4.4) for this analysis.

For the remainder of this section we will complete the rest of the game in the following order. First, we calculate prices and demand, and second, we derive equilibrium quality levels and lastly, we play the opinion game.

The Price Game

In order to derive the optimal prices we first need to calculate the demand functions faced by the newspaper contingent on the prices. First, we find the consumer who is indifferent between buying newspaper 1 and buying both, using Equations (3.1) and (3.3):

$$
\begin{aligned}
u_1^R &= u_{12}^R \\
\sigma v - (1-\lambda) \mid (1-z_2) - x \mid &= p_2 - \lambda q_2 \\
x_{12} &= (1-z_2) - \frac{\sigma v + \lambda q_2 - p_2}{(1-\lambda)}
\end{aligned} \tag{4.22}
$$

Similarly, we find the consumer who is indifferent between buying newspaper 2 and both using Equations (3.2) and (3.3):

$$
\begin{aligned}
u_2^R &= u_{12}^R \\
\sigma v - (1-\lambda) \mid x - z_1 \mid &= p_1 - \lambda q_1 \\
x_{21} &= z_1 + \frac{\sigma v + \lambda q_1 - p_1}{(1-\lambda)}
\end{aligned} \tag{4.23}
$$

Similar to the no quality case discussed earlier, we need to impose restrictions on the allowed locations of the firms and on the indifferent consumers in order to make sure that our solution is feasible. We can then rule out the possibility that $(1-z_2) - x_{12} < 0$

and $x_{21} - z_1 < 0$ as this would imply that newspaper 1 would locate itself to the right of its customers and for newspaper 2 to locate itself to the left of its customers. Also in this model iteration, we assume that no newspapers can locate outside the line, $z_1 \geq 0 \wedge 1 - z_2 \leq 1$.

The other set of locations that we also can rule out as possible Nash equilibria are combinations of z_1 and z_2 that makes one single-homing utility curve lie strictly above the other so that the lower newspaper has no customers. This means that we require the utility functions to intersect at some point along the line. This is the location of the indifferent costumer in the single-homing case. Recalling that $z_1 \leq 1 - z_2$ is always satisfied, we find the intersection by setting Equation (3.1) equal to (3.2):

$$\begin{aligned} u_1^R &= u_2^R \\ v - (1-\lambda) \mid x - z_1 \mid + \lambda q_1 - p_1 &= v - (1-\lambda) \mid (1-z_2) - x \mid + \lambda q_2 - p_2 \\ \mid (1-z_2) - x \mid - \mid x - z_1 \mid &= \frac{\lambda(q_2 - q_1) - p_1 + p_2}{(1-\lambda)} \\ \hat{x} &= \frac{1 + z_1 - z_2}{2} + \frac{\lambda(q_1 - q_2) + p_1 - p_2}{2(1-\lambda)} \end{aligned} \tag{4.24}$$

Similarly as in the first iteration, we use this intersection to form the range of possible combinations of z_1 and z_2, as illustrated in Figure 9. We have now established two restrictions for the locations of the newspapers. We can now turn our attention to the consumers. First, we require that both indifferent consumers lie within the Hotelling line. Formally, this means that we require $x_{12} > 0$ and $x_{21} < 1$. This restriction has an intuitive implication, namely that no newspaper covers the entire market (i.e. $D_1 < 1$ and $D_2 < 1$). By requiring that no newspaper covers the entire market, we assume that some consumers buy only newspaper 1, some buy only newspaper 2 and some buy both. Substituting Equations (4.22) and (4.23) into the inequalities yields the following restrictions:

$$\begin{aligned} \sigma v &< p_1 + (1-\lambda)(1-z_1) - \lambda q_1 \\ \sigma v &< p_2 + (1-\lambda)(1-z_2) - \lambda q_2 \end{aligned} \tag{4.25}$$

Interpreting these restrictions geometrically means that the incremental utility of buying the second newspaper σ is sufficiently low such that at least the consumer who is located farthest away will incur a net disutility by buying a second newspaper. Without this restriction, all consumers would have been able to multi-home.

Second, we require that at least some consumers multi-home. Using Equations (4.22) and (4.23), we require that

$$\begin{aligned} x_{12} &< x_{21} \\ (1-z_2) - \frac{\sigma v + \lambda q_2 - p_2}{(1-\lambda)} &< z_1 + \frac{\sigma v + \lambda q_1 - p_1}{(1-\lambda)} \\ \sigma v &> \frac{1}{2}((1-z_1-z_2) - \lambda(q_1+q_2) + p_1 + p_2) \end{aligned} \tag{4.26}$$

Again, we see that the value of purchasing the second good, σv, must lie in the interval formed by the imposed restrictions in order for there to exist a equilibrium. Table 2 sums up requirements imposed on the consumers.

Requirement	Constraint	Condition	Implication
Some buy both newspapers	$x_{12} < x_{21}$	$\sigma v > \frac{1}{2}((1-z_1-z_2) - \lambda(q_1+q_2) + p_1 + p_2)$	$D_1 + D_2 > 1$
Not all buy newspaper 1	$x_{12} > 0$	$\sigma v < p_1 + (1-\lambda)(1-z_1) - \lambda q_1$	$D_1 < 1$
Not all buy newspaper 2	$x_{21} < 1$	$\sigma v < p_2 + (1-\lambda)(1-z_2) - \lambda q_2$	$D_2 < 1$

Table 2: Consumer restrictions in second iteration

We know that the demands are on the form $D_1 = x_{21}$ and $D_2 = 1 - x_{12}$. Since z_i represents the location by newspaper i, the demands faced by the two newspapers can be written as

$$D_i = z_i + \frac{\sigma v + \lambda q_i - p_i}{(1-\lambda)} \tag{4.27}$$

In the third stage equilibrium locations z_i and quality q_i has already been decided in the first and second stage, respectively. Using the equilibrium revenue, Equation (4.4), from stage four we can rewrite the profit function:

$$\begin{aligned}\Pi_i &= D_i p_i + s_i A_i - \phi q_i^2 \\ &= D_i p_i + D_i k - \phi q_i^2 \\ &= D_i(p_i + k) - \phi q_i^2 \end{aligned} \tag{4.28}$$

where Equation (4.28) implies that k is the per copy subsidy paid by advertisers. The newspapers maximize their profits with respect to the price charged by the consumers, which is done with the first order condition:

$$\begin{aligned}\frac{d\Pi_i}{dp_i} &= \frac{\partial \Pi_i}{\partial p_i} + \frac{\partial \Pi_i}{\partial D_i}\frac{dD_i}{dp_i} = 0 \\ z_i &+ \frac{\sigma v + \lambda q_i - p_i}{(1-\lambda)} - \frac{p_i + k}{(1-\lambda)} = 0 \\ p_i^* &= \frac{(1-\lambda)z_i - k + \lambda q_i + \sigma v}{2}, \lambda \neq 1 \end{aligned} \tag{4.29}$$

The second order condition for a maximum is easily verified,

$$\frac{d^2\Pi_i}{dp_i^2} = -\frac{2}{(1-\lambda)} < 0 \text{ if } \lambda < 1.$$

The equilibrium prices is the solution to the third stage of the game. We see that prices increase as firms move closer to the center ($\partial p_i/\partial z_i > 0$) and the quality of the newspapers increase ($\partial p_i/\partial q_i > 0$), while prices decrease as the number of advertisers increase ($\partial p_i/\partial k < 0$). The first two findings is due to the fact that consumers value the newspapers higher when they are located closer, and that they value newspapers of higher quality. It is straightforward to note that prices increase in consumers reservation utility v, which also imposes an upper roof for consumers' willingness to pay. The last finding is due to the two-sidedness of the market: when the market for advertisers increase, the advertisers increasingly subsidize consumers, causing consumer prices to fall. We can now update the expression for demand by substituting Equation (4.29) into (4.27):

$$\begin{aligned} D_i &= z_i + \frac{\sigma v + \lambda q_i}{(1-\lambda)} - \frac{1}{(1-\lambda)} \frac{(1-\lambda)z_i - k + \lambda q_i + \sigma v}{2} \\ &= -\frac{z_i(1-\lambda) + k + \lambda q_i + \sigma v}{2(1-\lambda)} \end{aligned} \tag{4.30}$$

The Quality Game

In the second stage, newspapers invest in quality. Equilibrium locations z_i is given from the first stage. Formally, they maximize profits with respect to the quality:

$$\underset{q_i}{\text{maximize}}\ \Pi_i = D_i(p_i + k) - \phi q_i^2$$

We solve the quality game with the first order condition:

$$\begin{aligned} \frac{d\Pi_i}{dq_i} &= \frac{\partial \Pi_i}{\partial q_i} + \frac{\partial \Pi_i}{\partial D_i}\frac{dD_i}{dq_i} + \frac{\partial \Pi_i}{\partial p_i}\frac{dp_i}{dq_i} = 0 \\ \frac{\partial \Pi_i}{\partial q_i} &+ \frac{\partial \Pi_i}{\partial D_i}\left(\frac{\partial D_i}{\partial q_i} + \frac{\partial D_i}{\partial p_i}\frac{dp_i}{dq_i}\right) + \frac{\partial \Pi_i}{\partial p_i}\frac{dp_i}{dq_i} = 0 \\ q_i^* &= -\frac{\lambda(z_i(1-\lambda) + k + \sigma v)}{\lambda^2 - 4(1-\lambda)\phi}, \lambda \neq 1 \end{aligned} \tag{4.31}$$

We see that for the second order condition to be verified, we require ϕ to be sufficiently high. Namely,

$$\frac{d^2\Pi_i}{dq_i^2} = \frac{\lambda^2}{2-2\lambda} - 2\phi < 0 \text{ if } \phi > \frac{\lambda^2}{4-4\lambda}.$$

The equilibrium quality levels are the solution to the second stage. As expected, we see that the quality levels are increasing in the verifiability parameter, which represents consumers valuation of quality in their purchase decision ($\partial q_i/\partial\lambda > 0$).[59] Similarly, we also note that the quality levels indeed is decreasing in the investment cost ($\partial q_i/\partial\phi < 0$). Lastly, we look at the effect of opinions z_i on quality levels. The derivative is given

$$\frac{\partial q_i}{\partial z_i} = -\frac{\lambda(1-\lambda)}{\lambda^2 - 4(1-\lambda)\phi}.$$

We know that the numerator in the fraction above is negative because $0 < \lambda < 1$. We observe that the denominator is indeed also negative if $\phi > \lambda^2/(4-4\lambda)$, as we have assumed for the second order condition to be verified. Therefore, we conclude in this stage that quality levels are increasing as the newspapers move closer together. The intuition for this result goes as follows. As a newspaper moves closer to the middle, it is reaching more and more consumers who are willing to buy both products. By investing in quality, the newspaper will further increase its demand as well as being able to charge a higher price. Mathematically, this is inherent from the consumers utility functions: consumers value quality as well as reading news closer aligned with their existing opinions.

The Opinion Game

In the first stage, newspapers decide on the location of the opinion of the newspaper. To find this, we combine our findings so far in order to complete the profit function.

[59]To see that this indeed is positive we consider the derivative with respect to verifiability, which is given $\partial q_i/\partial\lambda = \left(z_i(\lambda^2+4(\lambda-1)^2\phi)+(\lambda^2+4\phi)(k+\sigma v)\right)/(\lambda^2+4(\lambda-1)\phi)^2$.

Combining Equations (4.29) and (4.31) yields the prices:

$$
\begin{aligned}
p_i^* &= \frac{(1-\lambda)z_i - k + \sigma v}{2} + \frac{\lambda}{2} - \frac{\lambda(z_i(1-\lambda)+k+\sigma v)}{\lambda^2 - 4(1-\lambda)\phi} \\
&= -\frac{2\phi(1-\lambda)(\sigma v - z_i(1-\lambda)) + k(\lambda^2 - 2(1-\lambda)\phi)}{\lambda^2 - 4(1-\lambda)\phi} \qquad (4.32)
\end{aligned}
$$

Similarly, by combining Equations (4.30) and (4.31) we find the demands:

$$
\begin{aligned}
D_i &= \frac{z_i(1-\lambda)+k+\sigma v}{2(1-\lambda)} - \frac{\lambda}{2(1-\lambda)} \frac{\lambda(z_i(1-\lambda)+k+\sigma v)}{\lambda^2 - 4(1-\lambda)\phi} \\
&= \frac{2\phi(-z_i(1-\lambda) - k - \sigma v)}{\lambda^2 - 4(1-\lambda)\phi} \qquad (4.33)
\end{aligned}
$$

We note that both demand and prices is increasing as the opinions move closer together ($\partial D_i/\partial z_i > 0$ and $\partial p_i/\partial z_i > 0$), as long as the investment cost ϕ is sufficiently high, $\phi > \lambda^2/(4-4\lambda)$. Lastly, by combining Equations (4.31), (4.32) and (4.33) we complete the expression for profits:

$$
\begin{aligned}
\Pi_i &= D_i(p_i + k) - \phi q_i^2 \\
&= -\frac{2\phi(z_i(1-\lambda)+k+\sigma v)}{\lambda^2 - 4(1-\lambda)\phi} \left(-\frac{2\phi(1-\lambda)(z_i(1-\lambda)+k-\sigma v)}{\lambda^2 - 4(1-\lambda)\phi}\right) - \phi \left(\frac{\lambda(-z_i(1-\lambda)-k-\sigma v)}{\lambda^2 - 4(1-\lambda)\phi}\right)^2 \\
&= \frac{\phi(-z_i(1-\lambda)-k-\sigma v)^2}{4(1-\lambda)\phi - \lambda^2} \qquad (4.34)
\end{aligned}
$$

We can now find the newspapers equilibrium opinions. We are interested in the sign of the first derivative of the profit function with respect to opinions z_i.

$$
\frac{d\Pi_i}{dz_i} = -\frac{2(1-\lambda)\phi(k - z_i(1-\lambda) + \sigma v)}{\lambda^2 - 4(1-\lambda)\phi}
$$

We see that profit is increasing in the location z_i ($\partial \Pi_i/\partial z_i > 0$) as long as $\sigma v > z_i(1-\lambda) - k$. This coincides with the restriction imposed in Equation (4.26). In words, this means that we require at least some consumers to multi-home. Consequently, newspapers profit by moving closer to the middle of the Hotelling line, and similarly as in the no quality case it suggests that there exists a Nash equilibrium with minimal differentiation $(z_1, z_2) = (1/2, 1/2)$. The possible equilibrium locations are illustrated in Figure 10.

As in the first iteration, we know that neither newspaper will have any incentive to deviate from the equilibrium tariffs, prices and quality levels, because both the first- second order condition is satisfied. The only possible deviation is hence such that no consumers choose to multi-home. Since we have already ruled this possibility out in order to ensure the existence of an equilibrium, this is not an option in our model. Returning to the first stage, as long as derivative $d\Pi_i/dz_i > 0$ is true, we know that the newspapers will locate in the middle. We have hence established our second proposition:

Proposition 2 *Minimal differentiation,* $(z_1, z_2) = (1/2, 1/2)$*, is a Nash equilibrium in a covered market required that some consumers multi-home, the investment cost is sufficiently high,* $\phi > \lambda^2/(4-4\lambda)$*, and news have intermediate fractions of verifiability,* $\lambda \in (0, 1)$.

The newspaper profits, prices and quality levels in the minimal differentiation position are found by substituting $(z_1, z_2) = (1/2, 1/2)$ into Equations (4.34), (4.32) and (4.31), and are given by

$$\begin{aligned}
\Pi_i^{min} &= \frac{\phi(-0.5(1-\lambda)-k-\sigma v)^2}{4(1-\lambda)\phi-\lambda^2}, \\
p_i^{min} &= -\frac{2\phi(1-\lambda)(\sigma v-0.5(1-\lambda))+k(\lambda^2-2(1-\lambda)\phi)}{\lambda^2-4(1-\lambda)\phi} \text{ and} \\
q_i^{min} &= -\frac{\lambda\,(0.5(1-\lambda)+k+\sigma v)}{\lambda^2-4(1-\lambda)\phi}.
\end{aligned}$$

In Figure 11, we have plotted the equilibrium levels of quality on the fraction of news verifiability for certain values of the parameters. As we know, the quality increases in consumers valuation of it, represented by λ. Further, we see that quality increases in consumers reservation utility v, and that it decreases in the cost of investing ϕ, as we would expect.

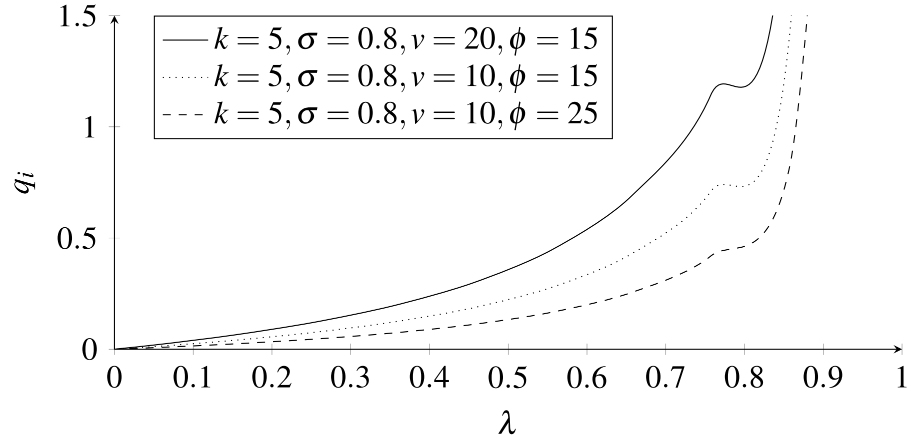

Figure 11: Plot of quality levels on verifiability

We have so far given little attention to the tariffs paid by advertisers. This is because, as we know from Equation (4.3), the tariffs are perfectly correlated with the demand for each newspaper: a result of our perfect elastic demand assumption. In Figure 12, we have plotted the equilibrium consumer prices p_i as well as the tariffs q_i on the fraction of verifiable news.[60] We see that both prices and tariffs increase in the verifiability of news. The intuition goes as follows. First, when the verifiability increases, we know that newspapers increase the investments in quality as consumers have increased valuation. Second, increased quality by the newspapers attract more consumers. It is straightforward to see that tariffs increase in demand. The fact that both prices and demand increase in the quality levels tells us that the price increase caused by a increase in quality must be small enough such that more consumers will start buying the newspapers.

[60]The plot is created assuming the following values: $k = 5, \sigma = 0.8, v = 10, \phi = 15$. From Equation (4.3), we see that tariffs is simply the demand divided by two. Figure 12 is hence simply made by using the equilibrium tariffs from Equation (4.33).

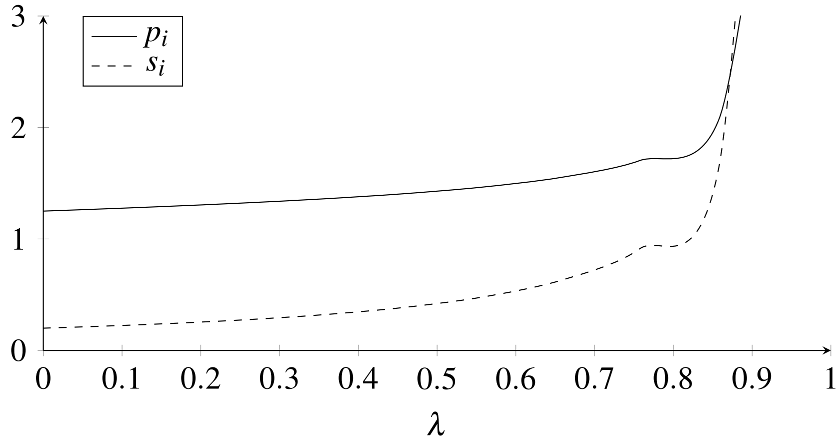

Figure 12: Plot of prices and tariffs on verifiability

4.3 Discussion of results

The purpose of our model is to give theoretical insights on what affects newspapers to hold political opinions. Although our model is far too theoretical to be directly applied in real life, it still offers interesting results that can be used to explain effects and intuition in the news market. As the media- and news-market continues to evolve at great speeds in the digital era, it grows increasingly compelling to examine the drivers of the observed changes in the modern news climate.

In both iterations of the model, we see that the outcome of the opinion game is the same, namely that each newspaper will choose a political opinion at the midpoint of the Hotelling line. We have shown that this is the case because the newspapers' profits are increasing in distance, z_i, towards the middle of the *Linear City*.

These results offer some merit to those who claim that the true political diversity in news stories is quite low, and similar to Gabszewicz et al. (2001, 2002) one can argue the reason is that most newspapers gather at the center of the political spectrum in order to attract more readers and advertisers. According to Allern (2007), this was the reason the Norwegian "party press" was abolished in the 1990s. This congregation towards the center may not be aligned with the political preferences of the newspaper editors, but since the market is two-sided in nature the newspapers have incentives to appeal to the masses so that they can earn more from advertisements, it still ends up happening.

In this paper, we have relaxed Hotelling's assumption that a consumer can only buy one of two goods. By allowing consumers to buy both goods, we have shown that the Principle of Minimal Differentiation is intact in a model of linear transportation costs, as Hotelling originally formulated it. However, in both analyses of the model, the results are given that certain conditions are met. The strongest of which is that at least some consumers multi-home, as the results would be unstable if this was not the case.

There are only two existing papers that investigate endogenous location decisions in multi-homing models. Both Kim and Serfes (2006) and Anderson et al. (2016) showed that there exists an equilibrium with minimal differentiation. Kim and Serfes found that a minimal differentiation equilibrium is contingent on that the consumers' valuation of the second exceeds a certain threshold (corresponds to σ in our model). Anderson et al. found that minimal differentiation is the solution only if advertisers (and newspapers) value each consumer equally even if they reach the same consumer several times. Our result in the opinion game is hence a duplication of these previous studies.

Where Kim and Serfes show that the alternative is maximal differentiation, if no consumers choose to buy both products, our model only gives instability and does not yield equilibrium locations due to the specification of the model. Requiring some consumers to multi-home might be a even more unrealistic assumption than assuming that no one does. This is a major downside of the model, as the model is not able to capture a central mechanism at work. On the other hand, by using linear transportation costs we have given easy spatial and economic interpretations of the model, which certainly is one of the strengths of the linear approach.

We have identified the aggregate demand creation effect as first pointed out by Kim and Serfes (2006). We see that the first iteration of the model predicts that demand decrease in the transportation preference t. This is inherent from the fact that as the transportation cost increase, consumers incur a higher cost of buying both newspapers. Consequently, the number of multi-homers will decrease. The effect of t also manifests itself in consumer prices. When t increases, each newspaper marginally increase its market power and subsequently increases prices as a result of relaxed competition in price. We see that for the model to give equilibrium solution in the opinion game, we need to require $t \leq 2$. This is because if the transportation preference exceeds the threshold, no consumers will want to multi-home. In this case, we will be thrown into instability due to intensified price competition (d'Aspremont et al., 1979). We know that advertisement tariffs s_i is contingent on consumer demand, and subsequently, the model predicts a decrease in tariffs due to a increased t.

The fact that the newspapers get revenue from two sources, namely consumers and advertisers, does not affect the result of the opinion game as long as we require some consumers to multi-home. In their quadratic transportation cost model, Gabszewicz et al. (2001, 2002), on the other hand, find newspaper will choose a minimal differentiation strategy given sufficiently large advertisement market k. While k does not influence the chosen opinions of the newspapers, it does have an effect on prices, demand, and profit. Advertisers' willingness to pay for advertisement is increasing in consumer demand for the newspaper. Newspapers hence have an incentive to lower consumer prices when k is high in order to attract consumers such that more advertisers will buy more advertisement in the newspaper. Therefore, the model predicts that consumer prices are decreasing in size of advertisement market k.

The second iteration is slightly more complex and gives us insight about the effect of verifiability, measured by fraction λ, and investment cost ϕ. The model predicts increased quality levels in consumers' valuation λ, while quality levels decrease in investment cost ϕ. Inherited from the relationship with quality levels, the model predicts increased prices and demand in λ and decreasing prices and demand in ϕ.

When consumers have a demand for more than one product, this implies that consumers to some degree seek variety (Sajeesh and Raju, 2010). When, in equilibria, the newspapers end up completely similar, one can imagine that there is no reason for consumers to buy both newspapers and reading the same piece of news twice. As we pointed out, this is a major downside of the model. Similarly, when the newspapers are identical, why not just buy two copies from one firm? The assumption that consumers can only buy one newspaper from each also seems quite strong in light of our minimal differentiation result. Instead, we can imagine that the single-homing consumers simply randomize what newspaper they buy.

As shown in Figure 10, we assume that the utility of reading one newspaper is higher than the utility from multi-homing near the end points of the Hotelling line. We also assume that the single-homing utility is larger than zero. In other words, we assume that the market is covered and that not all consumers buy both products. It could well be the case that some consumers choose to not read any newspapers instead of deciding to single- or multi-home. Therefore, it can be argued that this assumption is an overly strong one compared to what might be the case in reality. However, we decide to assume a covered market in order to simplify the model and rather focus our analysis on other interesting implications.

If we relax this assumption and allow for the market to be uncovered, this implies there is a length left of x_{12} and right of x_{21} in Figure 10 where the consumers obtain higher utility by not reading any newspaper compared to reading one or two newspapers. These consumers may be characterized as readers with political opinions, which vary wildly from what the newspapers in the market supply in their news distribution. We could then define $\tilde{x_1}$ as the point where a consumer is indifferent between reading the left-most newspaper and not reading any newspaper. To find this point, we would solve $u_1^R(\tilde{x_1}) = 0$. Similarly, for the right side indifferent consumer we could find point $\tilde{x_2}$ by solving $u_2^R(\tilde{x_2}) = 0$.

Furthermore, two additional interesting points would arise: The points where consumers are indifferent between reading both paper 1 and paper 2 and the indifferent reader between both papers and paper 1. Analyzing the new points on the Hotelling-line arising from allowing an uncovered market would lead to different restrictions in the model, and the equilibrium demand-, profit-, and price-functions are likely to change. A comparison between the different expressions stemming from a covered and an uncovered market would not make much sense since the assumptions which these versions are based on differ and are highly unlikely to hold at the same time.

We also assume that no newspaper can locate outside the Hotelling line, $z_1 \geq 0 \wedge 1 - z_2 \leq 1$. An equilibrium like this can be viable in a mathematical sense and interesting in the context of our model. News outlets classified as extreme on the left or the on right such as Breitbart News may have economic incentives to locate to the right of the Hotelling line (and also to the right of all its consumers). Such an incentive might be to differentiate completely from the mainstream market for news and rather appeal to a particularly right or left-wing demographic.

In the model, we require marginal cost, c_i, to be equal for the two newspapers and to lie below a certain level in the first iteration of the model. In the second iteration of the model, we set marginal costs equal to zero to simplify our expressions. Using different marginal costs for the two newspapers would lead to unnecessary complications and possibly stability issues in the model without adding much insight. This, in addition to the fact that previous literature on the subject uses equal marginal costs or set it to zero supports our choice. Also, in the modern era of newspapers in reality have a marginal cost equal to or close to zero due to modern printing technology and the fact that an increasing amount of news is distributed online.

5 Conclusion

In this paper, our aim is to identify the dynamics in the market for news in order to understand why newspapers hold political opinions in their coverage of the news. We review existing literature on the topic of media bias and media diversity, and propose a simple theoretical model of spatial competition in a two-sided media market with vertical differentiation.

There are two central premises of our model. First, we allow consumers to multi-home. Second, we incorporate a "confirmatory bias" in consumers' valuation of news reports. More specifically, we assume consumers' valuation of reading news closer aligned with their own political opinion is given by the share of unverifiable facts in a news report. Alternatively, when the share of verifiable facts is high, consumers prefer reading news of high quality. We take the share of verifiable facts as exogenously given. One could relax this assumption. Perhaps a more realistic assumption is that the share of verifiable facts is impacted by how much resources the newspapers devote to "searching for the truth". Then, the parameter for verifiability would be affected of the market structure. For example, the newspapers incentives to search for the truth might be impacted of their ability to extract rents from being the first to "break the truth". Examining such a model for endogenous verifiability based on the market structure is outside the scope of the present paper, but is a possible area for further research.

In our equilibrium analysis, we find that the equilibrium newspaper locations are in the middle of the political spectrum, meaning that the newspapers will give a "fair and balanced" presentation of the news, without *slanting* either left or right. The driving force behind this result is what Kim and Serfes (2006) named the *aggregate demand creation effect*, which means that the newspapers have incentives to move closer to the center in order to increase the amount of people buying both newspapers. The result is hence contingent on the fact that there in fact are *some* consumers who buys both.

Mathematically, this implies that consumers' valuation of buying a second newspaper is sufficiently high. As a consequence of the specification of the model with linear transportation costs, the equilibrium is unstable if no consumers buy both.

Following recent contributions in the multi-homing literature (e.g. Anderson et al., 2016, 2017), we find that the newspapers choices of prices, quality levels and locations are independent of each other in the presence of multi-homers, implying that each newspaper editor acts as a monopolist. Additionally, we show that the quality of newspapers and prices are increasing in the verifiability of news.

We review both theoretical and empirical research on media bias. The theoretical research is separated into two categories based on the assumption of where the bias is stemming from, namely the demand side and supply side. Here, we find that although many researchers have developed theoretical models to illustrate how media bias arises in different markets, there is a lack of empirical work to confirm or reject these models' predictions. Furthermore, there are few scholars who incorporates multi-homing in their research.

Our result of minimal differentiation is consistent with what Gabszewicz et al. (2001, 2002) and Garcia Pires (2014) found. In their models, they found that newspapers have an incentive to reduce the amount of slanting in order to attract more consumers, which subsequently attracts more advertisers. This result is also in line with Herman and Chomsky (1988), who argued that increased dependence on financing from advertisers would lead to minimal political differentiation among newspapers. Our results are the opposite of Mullainathan and Shleifer (2005), who found that newspapers would slant towards extreme results. We are, however, also in line with Gal-Or et al. (2012), who found that when the heterogeneity among advertisers is insignificant, newspapers political diversity should tend toward minimal.

Increased possibilities for target advertising is an interesting problem that arises with emerging technology. In our model, we assume that the demand by advertisers is perfectly elastic. Several of the papers we have reviewed depart from this strong assumption (e.g. Blasco et al., 2016; Ellman and Germano, 2009; Gal-Or et al., 2012; Germano and Meier, 2013). It is evident that that modelling both sides of the market realistically is important for economic models to give reasonable predictions. Investigating the impact on alternative advertisement demands with relation to the verifiability of news is hence also a possibility for future research.

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